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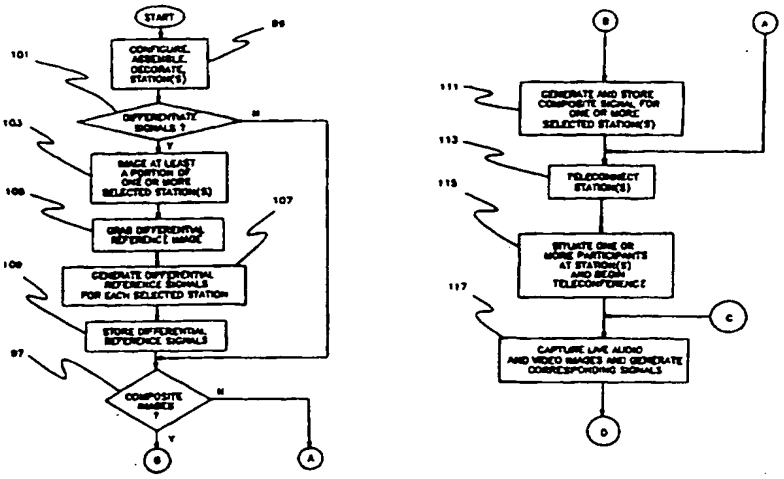

(57) Abstract

A method and system (10) provides a face-to-face video conference utilizing a video mirror comprising a first station having a first predetermined sensory setting; a second station having a second predetermined sensory setting; and an imaging system for capturing an image or sub-image at the first station, displaying at least a portion of said image or sub-image at the second station. The imaging system includes a differentiator for generating a differential signal (101) in response to a comparison of a differential reference signal to an input signal generally corresponding to the image captured at the first station. The imaging system also include a compositor for compositing the differential signal with one or more other image signals and/or a predetermined composite signal to provide a composited video image (97) which appears visually contiguous and seamless.

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TELECONFERENCING METHOD AND SYSTEM

Background of the Invention

The present invention is related to a video conferencing system and method and, more particularly, to a teleconferencing system which is capable of producing a "video mirror" at a station such that any participants at one or more remote stations may be imaged and displayed in the video mirror at the station so that they appear to be present or face-to-face with any participants at the station.

Visual telephone systems presently provide communication between at least two locations for allowing a video conference among participants situated at each station. An objective in some video conferencing arrangements is to provide a plurality of television cameras at one location. The outputs of those cameras are transmitted along with audio signals to a corresponding plurality of television monitors at a second location such that the participants at the first location are perceived to be present or face-to-face with participants at the second location. In achieving good face-to-face presence, the number of conferees included in the video picture from each camera is normally limited to a few people, typically one to four. There are usually a like number of monitors at the receiving station, each strategically focused, aligned and positioned so that their displays appear contiguous, seamless and properly aligned. The apparatuses and methods employed heretofore to achieve proper positioning, focus and alignment have been complex and costly.

Further, the images captured by the plurality of cameras must be arranged and displayed so that they

generate a non-overlapping and/or contiguous field of view, for example, as described in U. S. Patent No. 4,809,314 which issued to Judd et al. on December 26, 1989 and which is hereby incorporated by reference and made a part hereof.

The prior art systems have also been deficient because they have failed to provide means for generating an image, such as an image of a plurality of participants, at one station, differentiating the image to provide a differentiated image and subsequently compositing the differentiated image with a predetermined composite image to provide a composited image which complements or becomes visually complementary, contiguous or integrated with the remote station when the image is displayed at the remote station.

Another problem with prior art video conferencing systems is eye contact among participants at the stations. Typically, a camera is placed somewhere above the display monitor at which a participant is observing a display of the participant from the remote station. Consequently, the camera captures the participant at an angle above the participants viewing level or head. Thus, when an image of that participant is displayed at the remote station, it appears as if the participant is looking down (e.g., towards the ground). Previous solutions to this problem have required complex optical systems and methods using, for example, a plurality of lenses and mirrors. The solutions have usually been designed for use when the camera is capturing an image of a single participant, and they fall short when simultaneously capturing images of multiple participants.

The prior art stations themselves were not architecturally designed in a modular form so that they

could be easily assembled, decorated and combined with a video image or sub-image from the remote station in a manner which would enhance the virtual presence environment.

Summary of the Invention

It is, therefore, a primary object of the present invention to provide a face-to-face teleconferencing system which enables a plurality of participants at a plurality of stations to teleconference such that the participants generally appear face-to-face with one or more participants at remote stations in the teleconferencing system.

Another object of this invention is to provide a differentiator or differentiating means which facilitates differentiating at least one image captured at a station into a differentiated image which will ultimately be transmitted to at least one remote station.

Another object of this invention is to provide a method and system for compositing an image or sub-image received from a remote station with a predetermined composite image to provide a composited image, at least a portion of which is displayed at the station.

Still another object of the invention is to provide a system or method which provides a display having wide aspect ratio while utilizing cameras which generate images having smaller aspect ratios.

Still another object of the invention is to provide a method and system for defining a predetermined sensory setting at one or more stations in order to enhance the virtual presence environment at that station.

Still another object of the present invention is to provide a method and apparatus for imaging subjects at one station, processing such images, and displaying

such images at a remote station such that such images complement and become and/or become visually integrated with the remote station.

Another object of this invention is to provide a method and apparatus which is capable of generating a composite image having a plurality of different resolutions.

Still another object of the present invention is to provide a "video mirror" at a station.

Yet another object of the invention is to provide an imaging system which provides a simplified means capturing substantially eye level images of participants at stations while also providing means for simultaneously displaying images at such stations.

Still another object of this invention is to provide a system and method for compositing a plurality of signals corresponding to a plurality of images from at least one station to provide a contiguous or seamless composite image.

Still another object is to provide a method and system for providing a plurality of teleconferencing stations that have complementary predetermined sensory settings which facilitate creating a face-to-face environment when images of such settings and participants are displayed at remote stations.

Another object of the invention is to provide a method and apparatus for generating a video mirror such that an image having a predetermined sensory setting of participants or subjects captured at one station may be displayed at a remote station having a different predetermined sensory setting, yet the remote participants will appear face-to-face in the same predetermined setting as the participants or subjects at the one station.

In one aspect, this invention comprises an image generator for use in a teleconferencing system comprising a differentiator for comparing a differential reference image to an input video image from a station and for generating a differential image in response thereto, and a compositor associated with a remote station for receiving the differential image and for combining that differential image with a predetermined composite image to provide a composite image.

In another aspect, this invention comprises a conferencing system comprising a first station comprising a first sensory area defining a first aura, a second station comprising a second sensory area defining a second aura, and an image system for generating a first station image of at least a portion of the first sensory area and also for displaying a composite image corresponding to the first station image at the second station such that the first and second auras become visually combined to provide an integrated face-to-face environment at the second station.

In another aspect, this invention comprises an image system for use in a conference environment comprising a station having a first conference area and a remote station having a remote video area, the image system comprising a compositor for compositing a first signal which generally corresponds to a video image of a portion of the first conference area with a composite reference signal to provide a composite image signal; and a display for displaying the composited image signal at the remote video area such that the first and second stations appear complementarily integrated.

In still another aspect, of the invention, this invention comprises a teleconferencing system comprising a sensory setting, a second station having a second

predetermined sensory setting; and an imaging system for capturing an image at the first station and displaying at least a portion of the image at the second station such that it becomes generally visually integrated with the second predetermined sensory setting.

In another aspect of this invention, this invention comprises a station for use in a teleconferencing environment comprising a first station predetermined setting, first image sensing means associated with the first station predetermined setting for capturing images at the station for transmission to a remote station, audio means for transmitting and/or receiving audio signals from at least one remote station, and display means for displaying an image including at least one sub-image transmitted to the station from the remote station so that the image becomes integrated with the first station predetermined setting to facilitate providing a face-to-face presence teleconference.

In still another aspect of the invention, this invention comprises a method for providing a virtual presence conference in a teleconferencing system having a first station and a second station comprising the step of displaying an image formed from at least one sub-image from the first station at a predetermined location in the second station such that the image becomes visually integrated with the second station to define a single predetermined aura at the second station.

In yet another aspect of the invention, this invention comprises a method for teleconferencing comprising the steps of teleconnecting a first station having a first setting to a second station having a second setting; and displaying a composite image including an image of at least a portion of the first station at the second station such that when the

composite image is displayed at the second station it cooperates with the second setting to facilitate providing a face-to-face environment at the second station.

In still another aspect, this invention comprises a method for teleconferencing comprising generating at least one first station signal generally corresponding to a first station image of the first station, comparing the at least one first station signal to a differential reference signal corresponding to a first reference image and generating at least one differential signal comprising a portion of the first station image in response thereto, compositing the at least one differential signal with a predetermined composite signal corresponding to a predetermined image to provide at least one composite image, and displaying the at least one composite image corresponding to the composite signal at a second station.

In yet another aspect, this invention comprises a method for generating a seamless image at a station from a plurality of sub-images at least one of which is received from a remote station comprising the steps of generating the plurality of sub-images, and combining the plurality of sub-images with a predetermined composite image to provide the seamless image.

These advantages and objects, and others, may be more readily understood in connection with the following specification, claims and drawings.

Brief Description of the Accompanying Drawings

Figs. 1A and 1B, taken together, show a teleconferencing system according to one embodiment of this invention;

Fig. 2 is a partly broken away top view of a first station of the teleconferencing system shown in Fig. 1A;

Figs. 3A and 3B, taken together, show another embodiment of the present invention wherein the stations have different predetermined sensory settings;

Figs. 4A and 4B, taken together, show still another embodiment of the invention having stations which have predetermined sensory settings which are designed, decorated and defined to be complementary and/or substantially identical;

Figs. 5A and 5B, taken together, provide a visual illustration of the images corresponding to some of the signals generated by the teleconferencing system; and

Figs. 6A-6D, taken together, show a schematic diagram of a method according to an embodiment of this invention.

Detailed Description of Preferred Embodiment

Referring now to Figs. 1A and 1B, a teleconferencing system 10 is shown having a first station or suite 12 and a second station or suite 14. The first station 12 comprises a first conference or sensory area 16, and the second station 14 comprises a second conference or sensory area 18-1, respectively. The first and second stations 12 and 14 also comprise a first video area 20 and a second video area 22-1, respectively, associated with the first and second conference areas 16 and 18-1. The first video area 20 is generally integral with a wall 32h in the first station 12. Likewise, the second video area 22-1 is generally integral with a wall 32h-1 in the second station 14. In the embodiment being described, the first and second

stations are geographically remote from each other, but they could be situated on the same premises if desired.

For ease of illustration, the construction and modular assembly of the stations in teleconferencing system 10 will be described in relation to the first station 12. As shown in the sectional top view of Fig. 2, the first station 12 is shown assembled or constructed into a generally elongated octagonal shape. The first station 12 comprises a plurality of modular members 32a-32h which include walls 32a, 32c-e, 32g-h, doors in wall members 32b and 32f and entry facade 32f-1. The first station 12 also comprises a ceiling 34 (Fig. 1A) which is mounted on the members 32a-32h with suitable fasteners, such as nuts, bolts, adhesives, brackets, or any other suitable fastening means. Notice that the ceiling 34 has a dropped or sunken portion 34a which supports appropriate lighting fixtures 56.

In the embodiment being described, each of the members 32a-32h and the ceiling 34 is molded or formed to provide or define an environment having a unique architectural setting and/or sensory setting. For example, as illustrated in Fig. 1A, the wall member 32a may be formed to provide a plurality of stones 36, a plurality of columns 38, and an arch 40 to facilitate defining a first predetermined setting 12a having a Roman/Italian motif, theme or aura. One or more of the members 32a-32h may be provided with inlays, wall decorations (like picture 58 in Figs. 1A and 2), or even a permanent frosted glass window and frame arrangement 42 mounted therein. Furthermore, members 32b and 32f (Fig. 2) may be provided with sliding doors 44 which facilitate entering and exiting the first station 12 and which are designed to complement or further enhance the Roman/Italian motif.

In the embodiment being described, notice that member 32h (Figs. 1A and 2) is formed to provide a stone and pillar appearance and texture complementary to the stone and pillar appearance and texture of the wall members, such as member 32a. Also, the member 32a may be shaped to frame or mask a rear projection screen 46, as shown. The function and operation of the rear projection screen 46 will be described later herein. In the embodiment being described, the rear projection screen 46 comprises a high resolution lenticular rear projection screen which is either integral with or mounted directly to member 32h to provide a first video area 20 having a usable projection area of about 52 inches by 92 inches with an associated aspect ratio of 16:9.

Each of the members 32a-32h and ceiling 34 are created in separate modular units using a plurality of molds (not shown). In the embodiment being described, a suitable material for molding the members 32a-32h and ceiling 34 to provide a granite-like appearance may be Gypsum, but they could be formed from other suitable material such as stone or clay-based materials, ceramic, paper, cardboard, foam, wood, Styrofoam and the like. As illustrated in 1A and 2, the member 32d may be provided with a shelf or mantle 33. The various members 32a-32h are assembled together as shown in Fig. 2 and secured together with suitable support braces 48 which may be secured to the walls 32a-32h with any suitable fastener such as screws, bolts, an adhesive or the like. After the first station 12 is assembled and the ceiling 34 is secured thereto, it has a length of about 14 feet, 6 inches (indicated by double arrow L in Fig. 2) and a width of about 12 feet, 0 inches (indicated by double arrow W in Fig. 2). The first station 12 has an approximate height from floor to ceiling 34 of about 8

feet, 6 inches. Further, the members 32a, 32c, 32e and 32g have a width (indicated by double arrow Y in Fig. 2) of about 5 feet, 0 inch. Finally, the back wall member 32d and front wall member 32h comprises a width of about 7 feet, 8 inches (indicated by double arrow X in Fig. 2).

After the members 32a-32h and ceiling 34 are assembled, the first station 12 may be further decorated, designed or ornamented with a plurality of subjects, decorations or ornaments which facilitate providing the first predetermined sensory setting 12a which defines a first aura, motif or theme. Likewise, the second station 14 maybe further provided or ornamented with a plurality of subjects, decorations or ornaments which facilitate providing a second predetermined sensory setting 14a which defines a second aura, motif or theme. For example, as illustrated in Fig. 1A, the predetermined sensory setting 12a of the first station 12 may be further decorated with a table 50, table decorations, pillar and wall decorations, carpet (not shown), plants 54 and other wall decorations (not shown) to further enhance the Roman/Italian motif, theme or aura. The first and second predetermined sensory settings 12a and 14a may also comprise appropriate lighting fixtures 56 and appropriate furnishings, such as chairs 60 and tables 61, which complement the predetermined setting to further facilitate defining the Roman/Italian theme or motif for the stations 12 and 14.

It should be appreciated that once the first and second stations 12 and 14 are assembled and ornamented or decorated to provide their respective first and second predetermined sensory settings 12a and 14a, they define an aura, theme or motif which facilitates providing or creating a very sensual and impressionable environment. Providing such a station, such as station

12, with a strong sensory environment facilitates enhancing the virtual presence illusion created by teleconferencing system 10 of the present invention.

It should also be appreciated, however, that although the first station 12 and second station 14 are shown in the embodiment in Figs. 1A and 1B as having complementary or similar first and second predetermined sensory settings 12a and 14a, they could be provided with first and second predetermined sensory settings 12a and 14a having different themes, motifs or auras. Thus, while the embodiment described in relation to Figs. 1A and 1B illustrate a first and second set of stations 12 and 14 having a Roman/Italian motif, another set of stations, such as station 12' and station 14' in the embodiment illustrated in Figs. 3A and 3B, may have at least one station having a different predetermined setting. For example, the second station 14' in Fig. 3B provides a setting 14a' which defines a Chinese aura, theme or motif.

It should also be appreciated that the members 32a-32h, ceiling 34 and associated predetermined sensory setting are provided to be transportable and capable of being assembled at any suitable location, such as an existing rectangular room, suite or conference area having dimensions of at least 20 feet x 20 feet x 9 feet. While it may be desirable to provide the first and second stations 12 and 14 in the teleconferencing system 10 with substantially the same dimensions, it should be appreciated that they could be provided with differing dimensions, depending on, for example, the number of participants at each station. It should also be appreciated that the second station 14 and other stations described herein would preferably be manufactured and assembled in the same or similar manner as the first

station 12. Also, the stations in the teleconference system 10 may be decorated with wall, ceiling and floor coverings to provide, for example, the first predetermined sensory setting 12a without using the pre-formed or molded modular members 32a-32h described above, although the use of such members may be preferable in this embodiment.

The teleconferencing system 10 also comprises conferencing means or a conferencing system means for teleconnecting the first and second stations 12 and 14 together to facilitate capturing an image or images at one of said stations and displaying at least a portion of the image or a sub-image at another of the stations such that it becomes generally visually integrated with the predetermined sensory setting at that station, thereby facilitating creating a "video mirror" and a "face-to-face" environment for the participant situated at that station. As shown in Fig. 1A, the conferencing system associated with the first station 12 comprises image sensor means, imager or image sensors for sensing images at the first station 12. For the embodiment shown in Figs. 1A and 2, the image sensor means comprises a plurality of cameras which are operably associated with the rear projection screen 46 of first station 12. In this regard, the plurality of cameras comprise a first camera head 62 and second camera head 64 which are operatively coupled to a first camera control unit 66 and second camera control unit 68, respectively. Notice that the first and second camera control units 66 and 68 are remotely situated from the first and second camera heads 62 and 64. This facilitates permitting the first and second cameras 62 and 64 to be placed directly in the projection path of the rear projection screen 46, without

substantially interfering with the video image being projected.

In the embodiment being described, the first camera head 62 and second camera head 64 are situated approximately 16 inches above the surface of table 50 which generally corresponds to the eye level of the seated participants situated at table 50. As illustrated in Fig. 2, the first and second cameras 62 and 64 are situated behind the rear projection screen 46 in operative relationship with a pair of 1-1/4 inch diameter openings 66 and 68, respectively. The first and second cameras 62 and 64 are mounted on a suitable narrow or non-interfering bracket (not shown) such that they can be positioned behind the rear projection screen 46 in operative relationship with openings 66 and 68, respectively. In the embodiment being described, the first and second cameras 62 and 64 are 1-1/4 inch by 1-1/4 inch 3-CCD camera heads which generate images having an aspect ratio of about 3:4 and a picture resolution of about 494 x 700 pixels. One suitable 3-CCD camera heads 62 and 64 and associated camera control units 66 and 68 may be Model No. GP-US502 manufactured by Panasonic Broadcast and Television Systems Company of Japan. It should be appreciated that while the teleconferencing system 10 shown and described in relation to Figs. 1A and 1B show image sensor means comprising a plurality of camera heads 62 and 64 and camera control units 66 and 68 situated at a station, a single camera may be used (as shown and described relative to the embodiment shown in Figs, 4A and 4B) or even multiple cameras could be used depending on such things as the size of the station, the number of participants situated at the station, and/or the aspect ratio of each camera head selected. It should also be appreciated that the camera heads 62 and 64 and

associated camera control units 66 and 68 are configured and positioned at the first station 12 to facilitate providing maximum vertical eye contact among participates in the teleconference, while minimally interrupting the substantially life-size video projection on the rear projection screen 46.

The conferencing means also comprises a first differentiator or differential key generator 70 (Fig. 1A) and a second differentiator or differential key generator 72, respectively. The camera control unit 66 generates an RGB analog signal I-62 which is received by the first differentiator 70, and the camera control unit 68 generates an RGB signal I-64 which is received by the second differentiator 72. The first and second differentiators 70 and 72 provide means for processing the image signals generated by the camera control units 66 and 68 to remove or differentiate any undesired portion of the images corresponding to the signals I-62 and I-64. For example, as described in detail later herein, it is desired in this embodiment to separate the image of the participants situated at the first station 12 from at least a portion of the first predetermined sensory setting 12a, such as the background behind the participants, in order to provide a differential signal VS-1 that has that portion of the first predetermined sensory setting 12A removed. This, in turn, facilitates transmitting the video image of the participants at the first station 12 to the remote second station 14 and also facilitates compositing the image with other images, as described below.

Suitable differentiators 70 and 72 may comprise the differential key generator shown and described in U.S. Patent No. 4,800,432, issued on January 24, 1989 to Barnett et al. and assigned to The Grass Valley Group,

Inc., which is incorporated herein by reference and made a part hereof.

The differential key generators 70 and 72 convert the I-62 and I-64 signals from RGB analog signals to digital image signals having corresponding images 104 and 106 (Fig. 5A), respectively. The differential key generators 70 and 72 compare the digital image signals to an associated differential reference signals DRS-62 and DRS-64, respectively, which generally corresponds to images 108 and 110 in Fig. 5A. As described in detail later herein, these images 108 and 110 comprise at least a portion of the first predetermined sensory setting 12a such as the background. The differential reference signals DRS-62 and DRS-64 are stored in appropriate storage 74 and 76 (Fig. 1A) associated with the differential key generators 70, 72, respectively. In the embodiment being described, the differential reference signals DRS-62 and DRS-64 comprise a reference frame of a video image grabbed by one or both cameras 62 or 64 situated at the first station 12 from a video sequence of the first predetermined sensory setting 12a of the first station 12 background where no participants, chairs, or other foreground elements are in place.

In response to the comparison, the first and second differentiators 70 and 72 generate differentiated video signals VS-1 and VS-2 (Fig. 1A), respectively. As illustrated in Fig. 5, the VS-1 and VS-2 signals generally correspond to the individuals situated at the first station 12 when viewed in the direction of arrow A in Fig. 2. As illustrated in the images 112 and 114 (Fig. 5) associated with the VS-1 and VS-2 signals, respectively, notice that the background area shown in images 104 and 106 has been removed and is tagged as a "zero" image area.

Advantageously, tagging at least a portion of the image represented by the VS-1 signal as "zero" background facilitates compressing the VS-1 and VS-2 signals and providing corresponding compressed CDS-1 and CDS-2 signals, thereby reducing the amount of transmission band width needed. This tagging also facilitates compositing or overlaying another predetermined image to provide a seamless composited image as described in detail below.

The video signals VS-1 and VS-2 are received by a first compression/decompression means or CODEC 78 and a second compression/decompression means or CODEC 80, respectively. The CODECs 78 and 80 also receive an audio signal AS-A1 and AS-A2 from suitable microphones 82 and 83, respectively, which may be positioned or concealed at an appropriate location in the first station 12, such as underneath or on top of table 50, as illustrated in Fig. 1A. The function of the first and second CODEC 78 and 80 is to compress video and audio signals for transmitting to remote stations, such as the second station 14, and also to decompress compressed video and audio signals received from remote stations. Consequently, the CODECs 78 and 80 are configured with suitable compression and decompression algorithms which are known to those of ordinary skill in the art. The CODEC Model No. Rembrandt II VP available from Compression Labs, Inc. of San Jose, California is suitable for use in the embodiment described herein, but it should be noted that other suitable compression/decompression means may be employed.

The CODEC 78 receives the video signal VS-1 and audio signal AS-A1, and CODEC 80 receives the video signal VS-2 and audio signal AS-A2. The CODECs 78 and 80, generate digital signals CDS-1 and CDS-2, respectively, in response thereto which are in turn

transmitted to remote station 14 via a transmission network 84.

The transmission network 84 may be configured as a private network, public circuit switch service, and it may utilize telecommunication and/or satellite technology. In the embodiment being described, the transmission network 84 preferably includes a plurality of T-1 lines (not shown) which are capable of accommodating bit streams having a suitable band width, such as 1.544 megabytes per second.

The teleconferencing system 10 and conference means associated with the first station 12 also comprises enhancing means for enhancing the resolution of an image or sub-image received from a remote station, such as the second station 14. In the embodiment being described, enhancing means comprises a first line doubler 86 and a second line doubler 88 which are operatively coupled to the first CODEC 78 and second CODEC 80, respectively. In this embodiment, the first and second line doublers 86 and 88 enhance the resolution and picture quality of at least a portion of the image corresponding to video signals VS-3 and VS-4 received from the CODECs 78 and 80, respectively, by about 50-150%. The VS-3 and VS-4 signals correspond to images or sub-images received from remote station(s), such as station 14, as described in detail below. One suitable line doubler is the Model No. LD 100 available from Faroudja Laboratories, Inc. of Sunnyvale, California, but other suitable enhancing means may be provided to provide greater or less enhancement of the images to be displayed. For example, lenses, mirrors, optical pixel interpolation or other electrical means may be employed as desired. It should also be noted that the present invention may be performed without

the use of any enhancing means without departing from the scope of the invention.

The first and second line doublers 86 and 88 generate enhanced video signals which are input into compositing means, compositor or video compositing multiplexer 92 for compositing the enhanced video signals associated with the images or sub-images received from the remote station(s) with one or more predetermined composite signals, such as predetermined composite signal A, corresponding to a predetermined composite image or sub-image which are stored in a suitable storage device 94 associated with the compositor 92. In the embodiment being described, the predetermined composite signal A corresponds to an image of at least a portion of first predetermined sensory setting 12a, such as the background of the first station 12. The video compositing multiplexer 92 composites the signals received from the first and second line doublers 86 and 88 with the predetermined composite signal A and generates a RGB analog composite signal in response thereto. It has been found that Model No. E-Space-1 available from Miranda Technologies, Inc. of Montreal and Quebec, Canada, is one suitable video compositing multiplexer 92.

The teleconferencing system 10 comprises a projector 96 coupled to the video compositing multiplexer 92 which receives the RGB composite signal and projects a corresponding image 90 (Fig. 1A) corresponding to the composite signal on the rear projection screen 46. The Model No. 3300 available from AMPRO Corporation of Titusville, Florida has been found to be a suitable projector 96. Although the embodiment has been described using projector 96 and rear projection screen 46, other suitable means may be employed for projecting or displaying the composited image. For example, a liquid

crystal display (LCD) or other electronic screen may be suitable to display images at a station. This may eliminate the need for the projector 96.

The projector 96 could be used with an optical system or a plurality of mirrors (not shown), or prisms (not shown) such that the projector can be positioned, for example, to the side or below the rear projection screen 46 or in a manner that permits the projector 96 to project the image towards a mirror (not shown), which causes the image to be projected on the rear projection screen 46.

As described in detail below, the composite signal and its corresponding image 90 generally comprise a video image of at least a portion of the first predetermined sensory setting 12a combined or composited with a differentiated image, such as an image of the participants from the second station 14 which correspond to the VS-3 and VS-4 (Fig. 1B) signals. Consequently, the resultant image 90 projected on screen 46 at the first station 12 complements or blends with the architectural motif, aura, theme or design defined by the first predetermined sensory setting 12a at the first station 12, such that the projected image 90 appears visually integrated with the first predetermined sensory setting 12a of the first station 12. This, in turn, causes any image of the participants situated at the second station 14 and included in the image 90 to appear to be face-to-face with participants at the first station 12 during the teleconference. The operation of the compositor 92 is described in more detail later herein.

It should be appreciated that the sub-images or images received from the remote station(s) typically have a resolution on the order of about 352 x 288 pixels and the predetermined composite signal A comprises a

resolution on the order of about 1280 x 1024 pixels. Thus, the resultant composite image 90 may comprise, for example, an image of the participants situated at the second station 14 having a first resolution and a background image of the first station 12 having a second resolution, which is higher than the first resolution. This enables compositor 92 to provide a composite image 90 which, when displayed on screen 46, gives the illusion or effect of a "video mirror" to the participants situated at the first station 12.

The teleconferencing system 10 also includes audio means comprising a plurality of speakers 100 and 102 (Figs. 1A and 2) which, in turn, receive audio signals AS-B1 and AS-B2 from CODECs 78 and 80, respectively. It should be appreciated that the audio signal AS-B1 and AS-B2 generally correspond to the audio associated with the sound (e.g., voices, music and the like) associated with the remote station(s), such as second station 14.

It should also be appreciated that the rear projection screen 46 and projector 96 are configured and selected to enable the teleconferencing system 10 to project the composited image 90 (Fig. A) at a predetermined scale, such as substantially full scale. In this regard, the compositor 92 comprises a scaler 95 which is integral therewith for scaling the composited signal associated with the composited image 90 to a desired or predetermined scale, such as substantially full scale.

Referring now to Fig. 1B, the second station 14 comprises similar components as the first station and such like components are labelled with the same reference numeral as their corresponding component in the first station 12, except that the components associated with

the second station 14 have a "-1" designator added thereto. Such components operate and function in substantially the same manner as described above with regard to the first station 12 with the following being some differences. The differential reference signals DRS-3 and DRS-4 (Fig. 5) associated with the second station 14 generally correspond to an image or sub-image of at least a portion of the second predetermined sensory setting 14a, such as the background 98-1, of the second station 14. Such sub-image or image may include at least a portion of the background 98-1 without any participants, chairs or other foreground subjects situated in the second station 14. Also, like the predetermined composite signal A stored in the storage 94 associated with the first station 10, a predetermined composite signal B may be stored in the storage 94-1 associated with the compositor 92-1 second station 14. The predetermined composite signal B may correspond to an image or sub-image of at least a portion of the second predetermined sensory setting 14a of the second station 14. Such sub-image or image may include, for example, an image of the walls 32a-1 to 32h-1 and conference area 18 or background of the second station 14. Notice that in the embodiment shown in Figs. 1A and 1B, the second station 14 has a second predetermined sensory setting 14a which mirrors or is complementary to the first predetermined sensory setting 12a. As described above, however, the first and second predetermined sensory settings 12a and 14a may be different.

A method of operating the teleconferencing system 10 will now be described in relation to Figs. 6A-6D. The modular components, such as members 32a to 32h and ceiling 34 for first station 10, decorations and the like, are configured, assembled and decorated (block 99

in Fig. 6A) at a desired location to provide a conference station comprising a predetermined sensory setting defining a predetermined theme, motif or aura. As mentioned earlier herein, the theme, motif or aura may be complementary (as shown in Figs. 1A and 1B) or they can be completely different, as shown in Figs. 3A and 3B (described below). For ease of illustration, it will be assumed that the stations are assembled and decorated as shown and described relative to the embodiment in Figs. 1A and 1B.

Once the modular stations 12 and 14 are assembled and decorated, it may be desired (decision point 101 in Fig. 6A) to use differentiator (e.g., differentiator 72 in Fig. 1A). As discussed herein relative to the embodiments shown in Figs. 4A and 4B, it may not always be desired to generate a differential reference image, thereby making it unnecessary to generate the differential reference signal. If differentiation is desired, then the camera heads 62 or 64 generate at least one video image (block 103) of at least a portion of the first predetermined sensory setting 12A at the first station 12. The differentiators 72 and 74 grab or capture at least one differential reference image or sub-image from those images and generate (block 107) the differential reference signals DRS-62 and DRS-64, respectively. These signals are stored in suitable storage 74 and 76 for use by the differentiators 70 and 72, respectively. Likewise, cameras 62-1 and 64-1 at the second station 14 generate video images of at least a portion of the second predetermined setting 14a at the second station 14. The differentiators 70-1 and 72-1 grab or capture at least one differential reference image or sub-image from those images and generate differential reference signals (not

shown) corresponding thereto. These signals are then stored (block 109) in suitable storage 74-1 and 76-1 for use by differential key generators 70-1 and 72-1, respectively.

As mentioned above, it is preferred that the differential reference signals DRS-62 and DRS-64 comprise an image of at least a portion of the first predetermined sensory setting 12a, such as an image of the first station 12 without any participants, chairs or other subjects which are not stationary during the teleconference. Likewise, it is preferred that the differential reference signals associated with the differentiators 70-1 and 72-1 comprise at least a portion of the second predetermined sensory setting 14a at the second station 14, such as an image of the background 98-1 without the participants, chairs and other subjects which are not stationary during the teleconference.

If differentiation of signals is not selected or at the end of the differentiation process, it may be desired to generate a composite image (decision point 97) for one or more of the stations. As discussed below, however, this may not always be required to achieve certain advantages of the invention. Such predetermined composite image would preferably include a substantial portion of the first predetermined sensory setting 12a, including the background and/or conference area 16 of the first station 12. If compositing is desired, then the predetermined composite signal A is generated (block 111 in Fig. 6B). The corresponding predetermined composite signal A may then be stored in suitable storage 94. In the same manner, the predetermined composite image at the second station 14 and corresponding predetermined composite signal B may be generated and stored as predetermined composite signal B in suitable storage 94-

1. In the embodiment being described, the predetermined composite image associated with the second station 14 includes an image of at least a portion of the second predetermined sensory setting 14a, including the background 98-1.

In the embodiment being described, the predetermined composite signals A and B are generated by a suitable still camera (not shown) to provide a still image (not shown) of the station 12 or 14 being photographed. The still image would subsequently be scanned and digitized for storage by a suitable scanner (not shown). The still camera and scanner would preferably be capable of generating images having a resolution on the order of about 1280 x 1024 pixels. Thus, if compositing is performed, the resultant composite image (such as image 90 in Fig. 1A) may comprise an image having a high resolution background, for example, combined with a comparatively lower resolution image of the remote station participants. This, in turn, facilitates enhancing the "video mirror" effect wherein a mimic or replication of a common architectural technique of mirroring a wall of a given room which makes the overall room appear to be extended beyond its actual wall line.

Once the stations 12 and 14 are configured and the differential reference signals and predetermined composite signals A and B are generated and stored, the first and second suites 12 and 14 may then be teleconnected (block 113) or connected by satellite or other suitable means via the transmission network 84.

Next, one or more participants may be situated at the first and second stations 12 and 14. As illustrated in Fig. 2, notice that the participants seated at the first station 12 are situated a

predetermined distance B from a participant's side 46a of the rear projection screen 46. The predetermined distance B generally corresponds to a preferred or optimum focal distance at which optimum imaging by cameras 62 and 64 may be performed. In the embodiment being described, it has been found that the predetermined distance should be about 5 feet, 6 inches. The participants are situated at the second station 14 in a similar manner and the face-to-face teleconference may then begin.

For ease of illustration, the imaging and display of first station 12 participants at the second station 14 will be described. The first and second cameras 62 and 64 capture (block 117 in Fig. 6B) live images of the participants situated at the first station 12 and generate corresponding RGB analog signals I-62 and I-64 which are received by the differential key generators 70 and 72, respectively. If differentiation was selected (decision point 147 in Fig. 6C), processing continues at block 119 otherwise it proceeds at block 123. The differential key generators 70 and 72 generate (block 121 in Fig. 6C) the digital differential signal VS-1 and VS-2, respectively, after comparing (block 119 in Fig. 6C) the I-62 and I-64 signals received from cameras 62 and 64 to their respective differential reference signals DRS 62 and DRS-64 which are received from storages 74 and 76.

The differential signals VS-1 and VS-2 are then received by CODECs 78 and 80 which also receive the audio signals AS-A1 and AS-A2 which correspond to the audio, including sounds, music and voices, associated with the first station 12. The CODECs 78 and 80 digitize the audio signals AS-A1 and AS-A2, combine the audio signals with their respective video signal VS-1 or VS-2, and

generate (block 123) the compressed CDS-1 and CDS-2 signals in response thereto. The CDS-1 and CDS-2 signals are then transmitted (block 125) to the second station 14 via the transmission network 84 (Fig. 1B).

The CDS-1 and CDS-2 signals are received and decompressed (block 127 in Fig. 6C) by CODECs 78-1 and 80-1, respectively, associated with the second station 14 to provide decompressed VS-1 and VS-2 signals. The CODECs 78-1 and 80-1 also decompress the audio signals AS-A1 and AS-A2 received from the first station 10 which are transmitted to speakers 100-1 and 102-1, respectively, at the second station 14.

Substantially simultaneously with the broadcasting of the audio signals at the second station 14, CODECs 78-1 and 80-1 decompress the CDS-1 and CDS-2 signals to provide VS-1 and VS-2 signals. The decompressed video signals VS-1 and VS-2 are then received by line doublers 86-1 and 88-1. If it is desired to enhance the signals (decision point 129), then the line doublers 86-1 and 88-1 process or manipulate the signals (block 131) in order to enhance the resolution of the image corresponding to those signals. After the signals VS-1 and VS-2 are processed, it may be desired to composite (decision point 133 in Fig. 6D) those signals with one or more other signals. In this illustration, for example, the video compositor 92-1 composites images (block 135) corresponding to those signals with at least one predetermined composite image, such as image 122 (Fig. 5B) corresponding to the predetermined composite signal B provided from storage 94-1 (Fig. 1B) to provide a composite signal. As mentioned above, the composite signal generally corresponds to the composited image 91-1 to be displayed on the rear projection screen 46-1 at the second station 14.

The compositor 92-1 may (decision point 137, block 139 in Fig. 6D) scale the composited image to a desired scale, such as full scale, using scaler 95-1. Thereafter, the compositor 95-1 transmits a corresponding RGB analog signal to projector 96-1 which displays (block 141) the scaled, composited image on the rear projection screen 46-1 (Fig. 1B).

The teleconference may then be continued or terminated as desired (decision point 143, block 145).

Because the composited image is substantially full scale when projected and includes a high resolution image of at least a portion of the second predetermined sensory setting 14a, the image appears to blend or become visually integrated with the second predetermined sensory setting 14a. This, in turn, gives the participants situated at the second station 14 the perception that the first station participants are present or face-to-face with them in the second station 14.

In the same or similar manner, images and signals relative to the second station 14 images are captured, processed and displayed at the first station 12. So that images of the participants at the second station 14 are displayed at the first station 12 such that they appear to have a face-to-face presence at the first station 12. Thus, images of the second station 14 participants may be differentiated and composited such that, when they are displayed at the first station 12, the image completes or provides "the other half" of the first station 12 and becomes generally visually integrated therewith. Although not required, it may be desirable to enhance the face-to-face presence by providing, for example, first and second predetermined sensory settings 12a and 14a which define a dining environment wherein food or meals may be served. For

example, the face-to-face presence may be further enhanced if the participants at both stations 12 and 14 order food and drinks from identical menus. Also, trained maître-de and/or waiters may be used to actively promote the perception of a face-to-face dinner using a scripted dialog and interaction with remote participants, maître-de and/or waiters.

Once the teleconferencing is terminated, the stations 12 and 14 may be used by the same or different participants without the need to reconstruct or re-assemble the stations.

Figs. 5A and 5B provide a visual illustration of the images corresponding to some of the signals described above utilizing the method and embodiment described above. In this regard, images 104 and 106 generally correspond to the actual images captured by the first and second cameras 62 and 64, respectively. As described above, associated image signals I-62 and I-64 are transmitted to the differential key generators 70 and 72, respectively. The differential key generators 70 and 72 compare the images 104 and 106 to the images 108 and 110 associated with the differential reference signals DRS-62 and DRS-64 which are received from storages 74 and 76, respectively, and which were previously generated by cameras 62 and 64 from an identical fixed camera position.

As illustrated in Fig. 5A, the differential key generators 70 and 72 generate differential signals VS-1 and VS-2 which have corresponding images 112 and 114. Notice that these images 112 and 114 comprise an image of the participants which are situated at the first station 12 with the background area having been removed or tagged as a "zero" area. As described herein, this "zero" area becomes "filled-in" with the desired or predetermined

composite image which may include, for example, an image of at least a portion of the predetermined setting or background of the second station 14. It has been found that removing a portion of the image, such as the background, by tagging it as zero, in the manner described herein, facilitates compressing the signals VS-1 and VS-2 and reducing the amount of bandwidth needed to transmit the images over transmission network 84 and between the first and second stations 12 and 14.

As mentioned above, the video signals VS-1 and VS-2 are fed into CODECs 78 and 80 which compresses the signals along with audio signal AS-A1 and AS-A2 and generates signals CDS-1 and CDS-2. The CDS-1 and CDS-2 signals are then transmitted, via transmission network 84, to the second station 14 and received by the CODECs 78-1 and 80-1 associated with the second station 14. As illustrated in Fig. 5B, the CODEC 78-1 and 80-1 decompresses the CDS-1 and CDS-2 signals, respectively, from the first station 12 and feeds them into associated line doublers 86-1 and 88-1. As mentioned earlier herein, the line doublers 86-1 and 88-1 facilitate enhancing the images associated with the video signals to provide enhanced video signals EVS-1 and EVS-2 (Fig. 5B), respectively.

As stated earlier, the enhanced video signals EVS-1 and EVS-2 are then received by the video compositing multiplexer 92-1 associated with the second station 14 wherein the signals are combined to provide an intermediate composite signal ICS having an associated intermediate composite signal image 120 having an aspect ratio of about 8:3.

The video compositing multiplexer 92-1 also receives the predetermined composite signal B having a predetermined composite signal B image 122 from storage

94-1. The video compositing multiplexer 92-1 composites or combines the images 120 and 122 to generate the composite signal having an associated or corresponding composite image 124 as shown in Fig. 5B. As stated earlier, the predetermined composite signal B image 122 generally corresponds to at least a portion of the predetermined setting or background of the second station 14 and has an aspect ratio of 16:9.

Notice that when the predetermined composite signal B image 122 is combined with the intermediate composite signal image 120, the video compositing multiplexer 92-1 causes the "zero" area of the intermediate composite signal image 120 to be "filled in" with the predetermined composite signal B image.

The composite image 124 may then be scaled to a predetermined size or scale, such as full scale, using scaler 94-1, so that the composite image 124 may be scaled to a substantially full scale or real-life size image as desired. The composite image signal corresponding to the composite image 124 is transmitted to the projector 96-1 and then displayed on the rear projection screen 46-1 at the second station 14. As illustrated in Figs. 1B and 5B, the composite image 124 may be appropriately framed or masked (such as with an archway 125 in Figs. 1B and 5B) when it is projected at the second station 14 to enhance the face-to-face, real time environment.

The audio and video signals transmitted between the first and second stations 12 and 14 may be, in this illustration, transmitted over separate T-1 lines (not shown) in the transmission network 84 in order to effect a substantially simultaneous and/or "real time" video conference. Thus, in the illustration shown in Figs. 1A and 1B, the participants may be geographically remotely

located, yet the participants situated at the first station 12 will feel as if the second station 14 participants are located face-to-face or present with them at the first station 12, while the participants situated at the second station 14 will feel as if the first station participants are face-to-face or present with them at the second station.

It should be appreciated that when the predetermined composite signal B and associated predetermined composite signal image 122 is composited with the intermediate composite signal and associated intermediate composite signal image 120, it overlays that signal to provide a seamless composite image 124, which facilitates reducing or eliminating the need to match up the borders or seams of the camera images with any high degree of accuracy. In this regard, it is preferable that cameras 62 and 64 and 62-1 and 64-1 preferably be situated such that they capture an entire participant rather than, for example, half of a participant. Thus, it may be desired to position the participants in a location such that any particular participants will not be in the field of view of more than one camera.

Advantageously, the invention provides an apparatus and method for providing a video mirror at each station 12 and 14 which facilitates creating a face-to-face and non-interrupted image of any participants in the video conference. Because the image of the participants is differentiated, less transmission bandwidth, computer memory and the like is required. Also, the differentiators and compositors of the present invention enable a user to create a composite image 124 (Fig. 5B) having at least a portion thereof imaged at a greater resolution than the portion which was transmitted over transmission network 84. This facilitates reducing the

effect of limitations or transmission restrictions of the transmission network 84 which, in turn, facilitates increasing the quality of images displayed at a station.

In addition, notice that the composite image 124 (Fig. 5B) may have an aspect ratio which is different from the aspect ratio of the cameras 62 and 64. This enables the system and method of the present invention to utilize cameras which generate images having smaller or even larger aspect ratios. This also enables the system and method to use cameras having standard or common aspect ratios, such as 4:3.

Figs. 3A and 3B, when taken together, illustrate another embodiment of the invention. The operation and components of the embodiment shown in Figs. 3A and 3B are substantially the same as the operation of components of the embodiment described above relative to Figs. 1A and 1B with the same reference numerals being used for the same components with the addition of single prime (') designator. Consequently this embodiment is similar to the embodiment shown in Figs. 1A and 1B, except that the second predetermined setting 14a' in Fig. 3B and its associated theme, aura or motif is substantially different from the second predetermined setting 14a shown in Fig. 1B. In Fig. 3B, the first predetermined sensory setting 12a' comprises a plurality of decorations 120 defining the Chinese theme, motif or aura. Also, the predetermined composite signal A stored in storage 94-1' and the differential reference signals stored in storages 74-1' and 76-1 would generally correspond to an image of least a portion of that setting 14a'.

As with the illustration described above relative to Figs. 1A and 1B, the video and audio signals would be processed in substantially the same manner. In

general, an image of the participants situated at the first station 12' is composited by compositor 92-1' with a predetermined composite image of at least a portion of the second predetermined sensory setting 14a' of the second station 14' and projected onto the rear projection screen 46-1' at the second station 14'. The first station 12' participants appear to be face-to-face with the second station 14' participants because they have a relatively high resolution video image behind them which complements or becomes integrated with the second predetermined sensory setting 14a'. Thus, as shown in Fig. 3B, the image 91-1' (Fig. 3B) of the ladies at the first station 12' includes a Chinese background which blends or complements the actual predetermined sensory setting 14a'.

Likewise, when the image of the participants situated at the second station 14' is projected on the rear projection screen 46' at the first station 12', they appear to be in the same room as the participants situated at the first station 12' because the Roman/Italian video background which is seen behind the second station 14' participants generally complements and becomes visually integrated with the actual Roman/Italian theme, motif or aura defined by the first predetermined sensory setting 12' of the first station 12'.

Figs. 4A and 4B, when taken together, illustrate another embodiment of the invention. The components of the embodiment shown in Figs. 4A and 4B which are substantially identical to the components in the embodiment shown in Figs. 1A and 1B which have the same reference numerals with the addition of a double prime ("''") designators. As illustrated in Figs. 4A and 4B, two remote modular stations such as stations 12'' and 14'' may be provided and designed to have first and

second predetermined sensory settings 12a'' and 14a'' which are substantially identical. Thus, as shown in Figs. 4A and 4B, images may be captured in the manner described above at station 12'' received by CODECs 78'' and 80'' and then transmitted, via transmission 84'', to associated CODECs 78-1'' and 80-1'', respectively. The CODECs 78-1'' and 80-1'' then generate a decompressed signal which may be enhanced by line doublers 86-1'' and 88-1'', respectively; scaled to an appropriate scale by scaler 95-1''; and then projected by projector 96-1'' onto rear projection screen 46-1''.

Notice that the image comprising the second station 14'' participants and second predetermined sensory setting 14a'' is displayed on screen 46'' at the first station 12''. Thus, this embodiment does not utilize the differentiating and compositing features of the previous embodiment, but may still achieve a face-to-face conference environment because the second predetermined sensory setting 14a'' is configured to be identical to or complementary with the first predetermined sensory setting 12a''. In this embodiment, entire images or sub-images of the stations 12 and 14 (including images of both participants and background) are displayed at remote station(s). Because the stations 12'' and 14'' are assembled, decorated and designed to be complementary or identical, they appear visually integrated to participants situated in the stations 12 and 14. Accordingly, the first and second predetermined sensory settings 12a" and 14a", including the background, are designed and arranged in a geometric fashion such that as cameras 62" and 64" capture images of the participants, they also capture images of the first and second predetermined sensory setting 12a" and 14a", respectively, at the most advantageous perspective for

display at the remote station(s). As with prior embodiments, this causes the first station 12'' participants to perceive that the second station 14'' participants are situated or present with the first station 12'' participants at the first station 14''. Likewise, the first station 12'' participants appear to be face-to-face with the second station 14'' participants at the second station 14'' when the images associated with the first station 12'' are displayed on screen 46-1''. Consequently, by providing complementary or identical first and second predetermined sensory settings 12a'' and 14a'', a face-to-face conference may be created. As with previous embodiments, it may also be desired to differentiate, enhance, composite or scale the images as described with previous embodiments, but this is not required with the embodiment being described.

Thus, it should be apparent that stations can be provided with predetermined settings which are completely different, yet, by utilizing the apparatus and method of the present invention, the images of the participants in these stations may be projected at remote stations so that they appear to be virtually face-to-face with the remote station participants at or one more remote station.

Various changes or modifications in the invention described may occur to those skilled in the art without departing from the spirit or scope of the invention. For example, the screen 46 for station 12 has been shown as being integral with a portion of a wall 32h (Figs. 1A and 2A), it could comprise a larger or smaller portion of that wall 32h, or it could be provided as part of one or more other walls, or even as part of the ceiling 34.

It should also be appreciated that while the embodiments have been shown and described comprising two stations, images from more than two remote stations may be displayed at a station, thereby permitting a teleconference convention among more than two stations.

Although not shown, one or more of the compositors, such as compositors 12 or 12-1 (Fig. 1A) may comprise a stationary or moving image database (not shown) for providing a plurality of predetermined composite signals which define a particular or desired video background. For example, participants may elect to use the arched background of their proximity, choose an event-related scene, or decide to meet in a setting completely unrelated to their site or station. For example, a station having a Manhattan eatery motif may be provided with a screen configured as a window (not shown). Certain moving video backgrounds of a busy New York avenue may be deposited and displayed on the screen to give the illusion that the participants situated at the station are dining in a popular Manhattan eatery.

It should also be appreciated that while the embodiments being shown and described herein refer to teleconferencing environments that have predetermined settings and motifs or auras relating to dining, the predetermined settings could define any type of aura, theme or motif which is suitable for video conferencing and in which it is desired to provide a "real-life" or face-to-face presence illusion. For example, the apparatus and method of this invention could be used in a business setting, education setting, seminar setting, home environment, religious setting, celebration setting (such as a birthday, retirement party, holiday or anniversary), or any other suitable setting as desired.

The above description of the invention is intended to be illustrative and not limiting, and is not intended that the invention be restricted thereto but that it be limited only by the spirit and scope of the appended claims.

What is claimed is:

1. An image generator for use in a teleconferencing system comprising:

a differentiator for comparing a differential reference image to an input video image from a station and for generating a differential image in response thereto; and

a compositor associated with a remote station for receiving said differential image and for combining that differential image with a predetermined composite image to provide a composite image which may be displayed at the remote station.

2. The image generator as recited in claim 1 wherein said differentiator comprises a differential key generator.

3. The image generator as recited in claim 1 wherein said differential image generally corresponds to an image of subjects situated at the station.

4. The image generator as recited in claim 1 wherein said differential reference image generally corresponds to at least a portion of the station.

5. The image generator as recited in claim 1 wherein said predetermined composite image generally corresponds to at least a portion of said remote station in the teleconferencing system.

6. The image generator as recited in claim 1 wherein the image generator further comprises:

at least one CODEC coupled to said differentiator and said compositor for facilitating exchanging signals therebetween.

7. The image generator as recited in claim 1 wherein said image generator further comprises an image enhancer coupled to said compositor for enhancing the resolution of said composite image by a predetermined amount.

8. The image generator as recited in claim 7 wherein said image enhancer is a line doubler.

9. The image generator as recited in claim 7 wherein said predetermined amount is on the order of about 50 - 150%.

10. The image generator as recited in claim 1 wherein said compositor comprises a scaler for scaling the composite image.

11. The image generator as recited in claim 3 wherein said subjects comprises at least one participant and at least one predetermined subject.

12. The image generator as recited in claim 5 wherein said portion comprises a background image.

13. A conferencing system comprising:

a first station comprising a first sensory area defining a first aura;

a second station comprising a second sensory area defining a second aura; and

an image system for generating a first station image of at least a portion of said first sensory area and also for displaying said first station image at said second station such that said first and second auras become visually combined to provide an integrated face-to-face presence environment at said second station.

14. The conferencing system as recited in claim 13 wherein said first station image comprises at least one sub-image of predetermined subjects situated in said first sensory area.

15. The conferencing system as recited in claim 13 wherein said image system comprises:

a compositor for compositing said first station image with a predetermined composite image to generate the composite image.

16. The conferencing system as recited in claim 15 wherein said compositor comprises a scaler for scaling the first station image.

17. The conferencing system as recited in claim 15 wherein said composite reference image comprises an image of at least a portion of said second sensory area of said second station.

18. The conferencing system as recited in claim 13 wherein said imaging system further comprises a differentiator for comparing said first station image with a differentiator reference image and generating said first station image in response thereto.

19. The conferencing system as recited in claim 18 wherein said differentiator comprises a differential key generator.

20. The conferencing system as recited in claim 13 wherein said conferencing system further comprises:

an audio transceiver device associated with said first and second stations for exchanging and broadcasting audio signals between said first and second sensory areas.

21. The conferencing system as recited in claim 13 wherein said first and second sensory areas are complementary.

22. The conferencing system as recited in claim 14 wherein said predetermined subjects are at least one participant and a plurality of predetermined decorations.

23. The conferencing system as recited in claim 13 wherein said image system further comprises:

a differentiator for generating a differential signal by comparing a first station image signal generally corresponding to said image to a differential reference image signal;

compositing means for combining said differential signal with at least one other signal to provide a display image for displaying at said second station.

24. The teleconferencing system as recited in claim 13 wherein said first and second auras are substantially identical.

25. The teleconferencing system as recited in claim 23 wherein said compositing means comprises:

a compositor associated with said differentiator for compositing said image signal with a predetermined reference image to provide a composite image for displaying at either said first or second station.

26. An image system for use in a conference environment comprising a station having a first conference area and a remote station having a remote video area, said image system comprising:

a compositor for compositing a first signal which generally corresponds to a video image of a portion of said first conference area with a composite reference signal to provide a composite image signal; and

a display for displaying said composited image signal at said remote video area such that said first and second stations appear complementarily integrated.

27. The image system as recited in claim 26 wherein said image system comprises:

a differentiator for generating the first signal in response to a comparison of a differential reference signal to an input signal corresponding to an image of said first conference area.

28. The image system as recited in claim 27 wherein said differential reference signal generally corresponds to an image of any desired subjects situated at said first conference area.

29. The image system as recited in claim 27 wherein said differentiator is a differential key generator.

30. The image system as recited in claim 26 wherein said image system further comprises:

an audio transceiver device for exchanging and broadcasting audio signals between said station and said remote station.

31. The image system as recited in claim 26 wherein said compositor comprises a scaler for scaling the composite image signal.

32. The image system as recited in claim 26 wherein said composite image signal corresponds to a composite image comprising a first image having a first resolution and a second image having a second resolution wherein said first and second resolutions are different.

33. The image system as recited in claim 32 wherein said first image corresponds to a background and said first resolution is higher than the second resolution.

34. The image system as recited in claim 26 wherein at least one of said station or said remote station is a modular construction.

35. A method for providing a virtual presence conference in a teleconferencing system having a first station and a second station comprising the step of:

displaying an image formed from at least one sub-image from the first station at a predetermined location in the second station such that said image becomes visually integrated with said second station to define a single predetermined aura at said second station.

36. The method as recited in claim 35 wherein said displaying step further comprises the steps of:

differentiating between an actual image of said first station and a reference image to provide said at least one sub-image.

37. The method as recited in claim 36 wherein said differentiating step further comprises the step of:

storing an image of at least a portion of said first station as said reference image.

38. The method as recited in claim 36 wherein said method further comprises the step of:

using a differential key generator.

39. The method as recited in claim 35 wherein said image is a composited image, said at least one of said at least one sub-image comprises a predetermined image, said displaying step further comprising the step of:

compositing said predetermined image with said at least one sub-image to provide said image.

40. The method as recited in claim 39 wherein said compositing step further comprises the step of:

scaling the image.

41. The method as recited in claim 35 wherein said method further comprises the step of:

enhancing the resolution of said image.

42. The method as recited in claim 39 wherein said enhancing step comprises the step of:

using a line doubler to enhance the resolution of said image.

43. The method as recited in claim 35 wherein said method further comprises the step of:

displaying said image on a rear projection screen integrally associated with said second station.

44. The method as recited in claim 35 wherein said method further comprises the step of:

using a CODEC to facilitate exchanging images between said first and second stations.

45. The method as recited in claim 35 wherein said method further comprises the steps of:

generating an audio signal associated with the image;

broadcasting said audio signal at said second station in general synchronization with said image.

46. The method as recited in claim 35 wherein said method further comprises the steps of:

generating an image having a first image having at least a first resolution and a second image having at least a second resolution, said first and second resolutions being different.

47. The method as recited in claim 46 wherein said first resolution is higher than said second resolution, said first resolution corresponding to a background of said second station.

48. A method for teleconferencing comprising the steps of:

teleconnecting a first station having a first setting to a second station having a second setting; and

displaying a composite image, including an image of at least a portion of said first station, at said second station such that when said composite image is displayed at said second station it cooperates with said second setting to facilitate providing a face-to-face presence environment at said second station.

49. The method as recited in claim 48 wherein said method further comprises the step of:

comparing an actual image of said first station to a differential reference image and generating said image in response thereto.

50. The method as recited in claim 49 wherein said method comprises the step of:

using a differential key generator to generate said image.

51. The method as recited in claim 50 wherein said differential reference image comprises at least a portion of said first setting.

52. The method as recited in claim 48 herein said method further comprises the step of:

compositing said image with a predetermined composite image to provide a seamless composite image.

53. The method as recited in claim 52 wherein said composite reference image comprises composite sub-images comprising a plurality of predetermined subjects.

54. The method as recited in claim 52 wherein said compositing step further comprises the step of:

scaling said composite image to a predetermined scale.

55. The method as recited in claim 49 wherein said method further comprises the step of:

compositing said image with a second reference image to provide a seamless composite image.

56. The method as recited in claim 53 wherein said plurality of predetermined subjects comprise the background of said second setting.

57. The method as recited in claim 48 wherein said method comprises the step of:

providing a first setting which generally complements said second setting such that when said composited image is displayed at said second station, said first and second settings become visually integrated to a participant situated at said second station.

58. The method as recited in claim 48 wherein said method further comprises the step of:

using a CODEC to effect facilitate transmitting images between said first and second stations.

59. The method as recited in claim 48 wherein said displaying step further comprises the step of:

compositing said composite image to have an aspect ratio of at least 4:3;

projecting said composite image in substantially full scale on a rear projection screen at said second station.

60. The method as recited in claim 48 wherein said displaying step further comprises the step of:

enhancing the resolution of said composite image.

61. The method as recited in claim 60 wherein said enhancing step further comprises the step of using a line doubler.

62. A method for generating a seamless image at a station from a plurality of sub-images at least one of which is received from a remote station comprising the steps of:

generating said plurality of sub-images; and

combining said plurality of sub-images with a predetermined composite image to provide said seamless image.

63. The method as recited in claim 62 wherein said generating step comprises the step of:

generating said plurality of sub-images using a plurality of image sensors.

64. The method as recited in claim 62 wherein said combining step comprises the step of:

providing a predetermined composite image which includes at least a portion of the background of said station.

65. The method as recited in claim 62 wherein said generating step further comprises the step of:

differentiating between an actual image and a differential reference image in order to generate said plurality of sub-images.

66. The method as recited in claim 65 wherein said method further comprises the step of:

using a differential key generator to generate said plurality of sub-images.

67. A method of generating an image for a video conference comprising the steps of:

capturing an image at one station,

filtering said captured image to provide a filtered image;

compositing the filtered image with a predetermined composite image to provide a composite image;

displaying the composite image at a remote station.

68. The method of claim 67 wherein said captured image comprises a participant image of at least one participant and a background image, said filtering step comprising the step of:

differentiating said captured image to separate the background image from the participant image to provide said filtered image.

69. A video mirror system for use in a video conference, comprising a plurality of stations comprising:

a display; and

an imager coupled to said display for generating a superimposed image comprising at least a portion of one of said plurality of stations with a remote image of at least one participant from a remote station and also for causing said display to display said superimposed images.

70. The video mirror system as recited in claim 69 wherein said imager comprises a differentiator.

71. The video mirror system as recited in claim 69 wherein said imager comprises a compositor coupled to said differentiator.

72. A method for generating a video scene at a station comprising the steps of:

providing a first image;

combining at least one remote image with the first image to provide a combined image; and

displaying the combined image at the station to facilitate providing a predetermined aura at the station.

73. The method as recited in claim 72 wherein said first image comprises a portion of the background of the station; said combining step comprising the step of:

differentiating an image captured at a remote station to provide said remote image.

74. The method as recited in claim 73 wherein said combining step of using a compositor to combine said at least one remote image with the first image.

75. The conferencing system as recited in claim 13 wherein at least one of said first or second stations comprise a modular assembly.

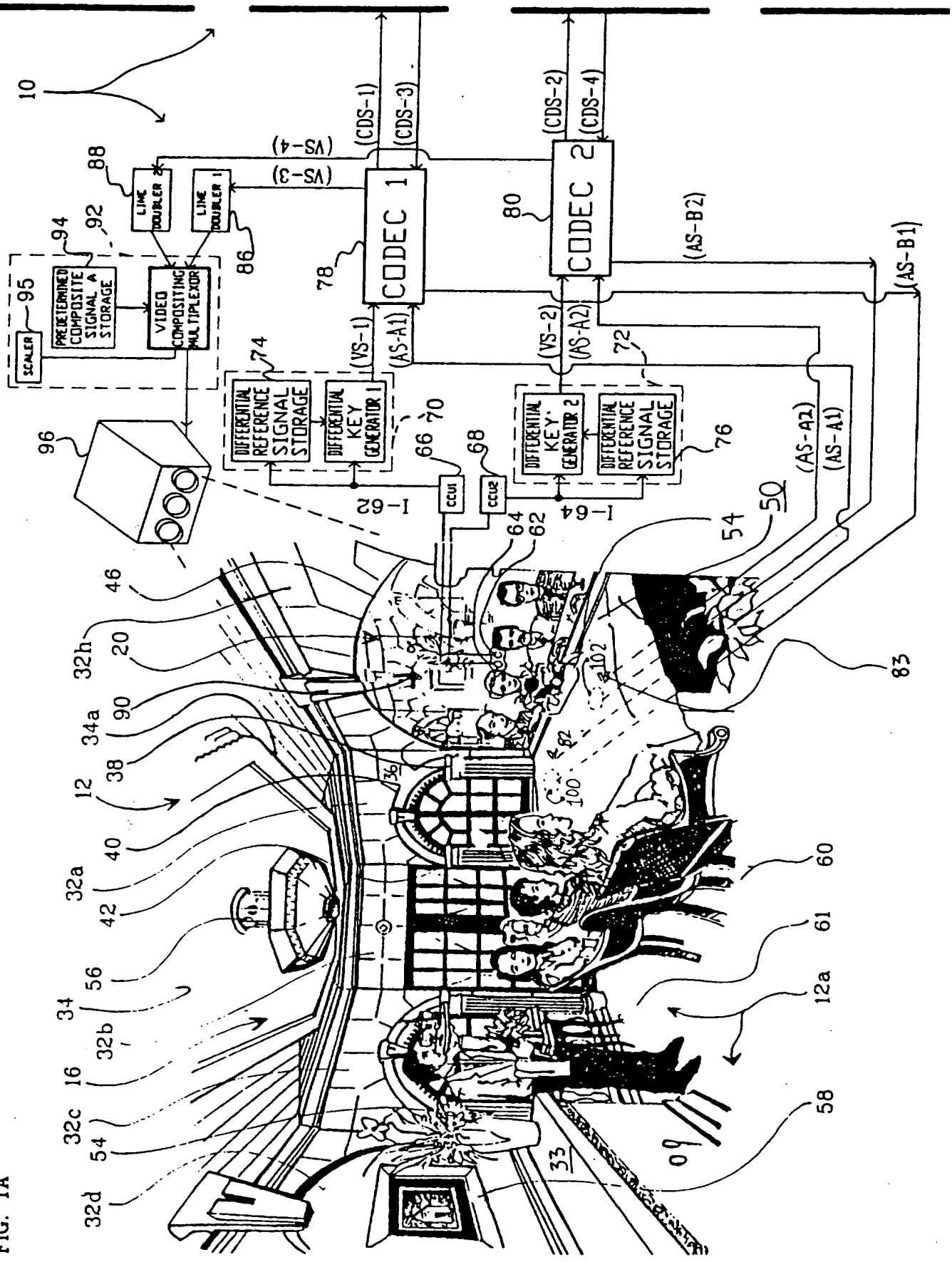

10
(VS-4)
(VS-3)
(CDS-1)
(CDS-3)
(CDS-2)
(CDS-4)
88
LINE DOUBLER 2
LINE DOUBLER 1
92
94
95
SCALER
PREDETERMINED COMPOSITE SIGNAL A STORAGE
VIDEO COMPOSITING MULTIPLEXOR
86
78
CODEC 1
80
CODEC 2
(AS-B2)
(AS-B1)
74
DIFFERENTIAL REFERENCE SIGNAL STORAGE
DIFFERENTIAL KEY GENERATOR 1
(VS-1)
(AS-A1)
(VS-2)
(AS-A2)
72
70
66
68
DIFFERENTIAL KEY GENERATOR 2
DIFFERENTIAL REFERENCE SIGNAL STORAGE
76
96
I-62
I-64
CCU1
CCU2
64
62
54
50
(AS-A2)
(AS-A1)
46
32h
20
90
34a
38
12
40
32a
42
56
34
32b
16
32c
54
32d
102
83
82
100
36
60
61
12a
58
33

FIG. 1A

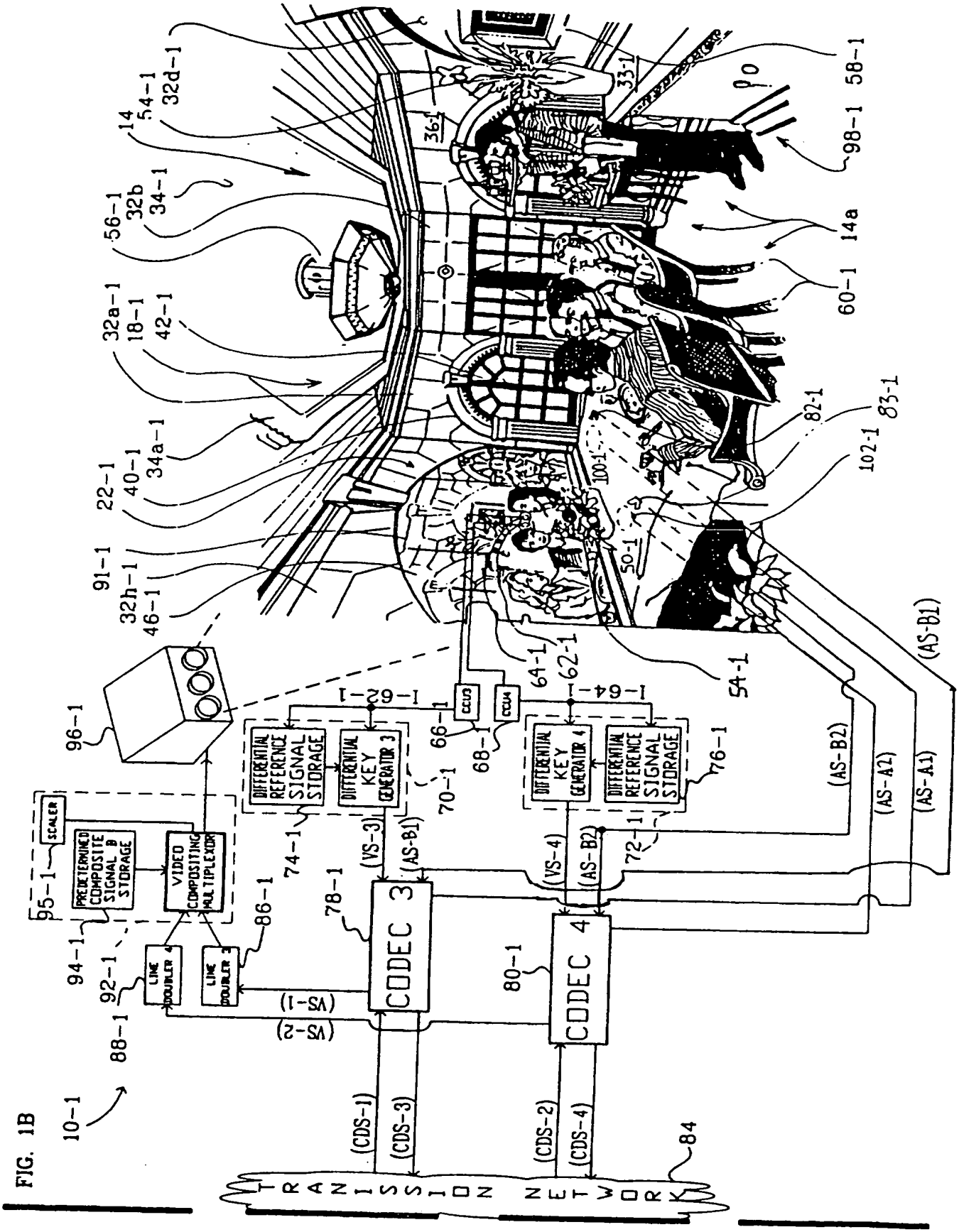
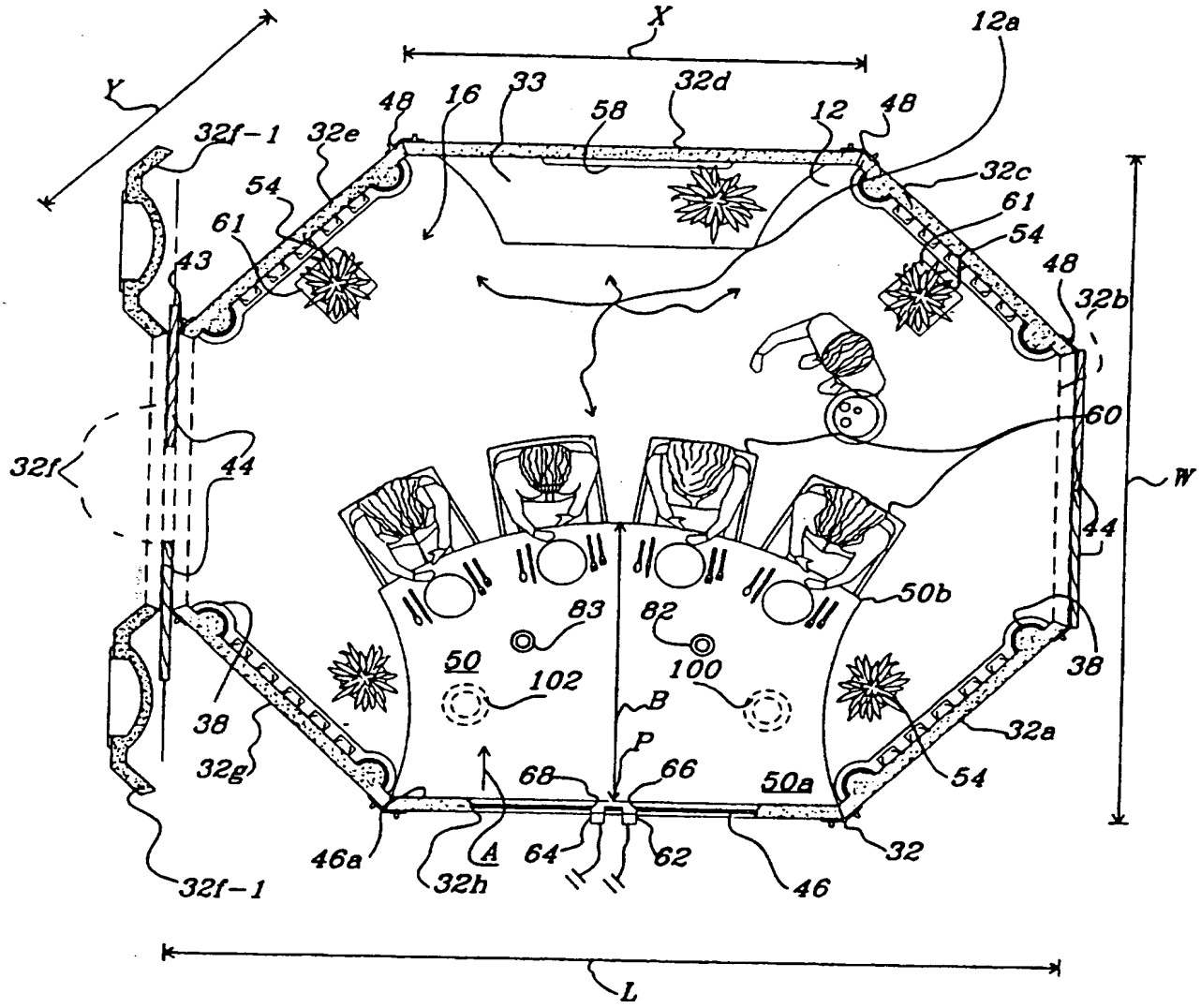

10-1
88-1
92-1
94-1
95-1
SCALER
PREDETERMINED COMPOSITE SIGNAL B STORAGE
VIDEO COMPOSITING MULTIPLEXOR
LINE DOUBLER 4
LINE DOUBLER 3
86-1
96-1
74-1
78-1
CODEC 3
80-1
CODEC 4
DIFFERENTIAL REFERENCE SIGNAL STORAGE
DIFFERENTIAL KEY GENERATOR 3
DIFFERENTIAL KEY GENERATOR 4
DIFFERENTIAL REFERENCE SIGNAL STORAGE
70-1
76-1
66-1
68-1
CCUS
CCUM
62-1
64-1
72-1
(VS-1)
(VS-2)
(VS-3)
(VS-4)
(AS-B1)
(AS-B2)
(AS-A2)
(AS-A1)
(CDS-1)
(CDS-3)
(CDS-2)
(CDS-4)
84
TRANSMISSION NETWORK
14
54-1
32d-1
56-1
32b
34-1
32a-1
18-1
42-1
22-1
40-1
34a-1
91-1
32h-1
46-1
36-1
33-1
98-1
58-1
14a
60-1
82-1
83-1
102-1
100-1
50-1
54-1

FIG. 1B

FIG. 2


X
Y
12a
48
16
33
58
32d
12
48
32f-1
32e
32c
54
61
61
54
43
48
32b
60
32f
44
W
44
50b
83
82
50
102
100
B
38
38
32g
P
68
66
50a
32a
54
46a
A
64
62
32
32f-1
32h
46
L

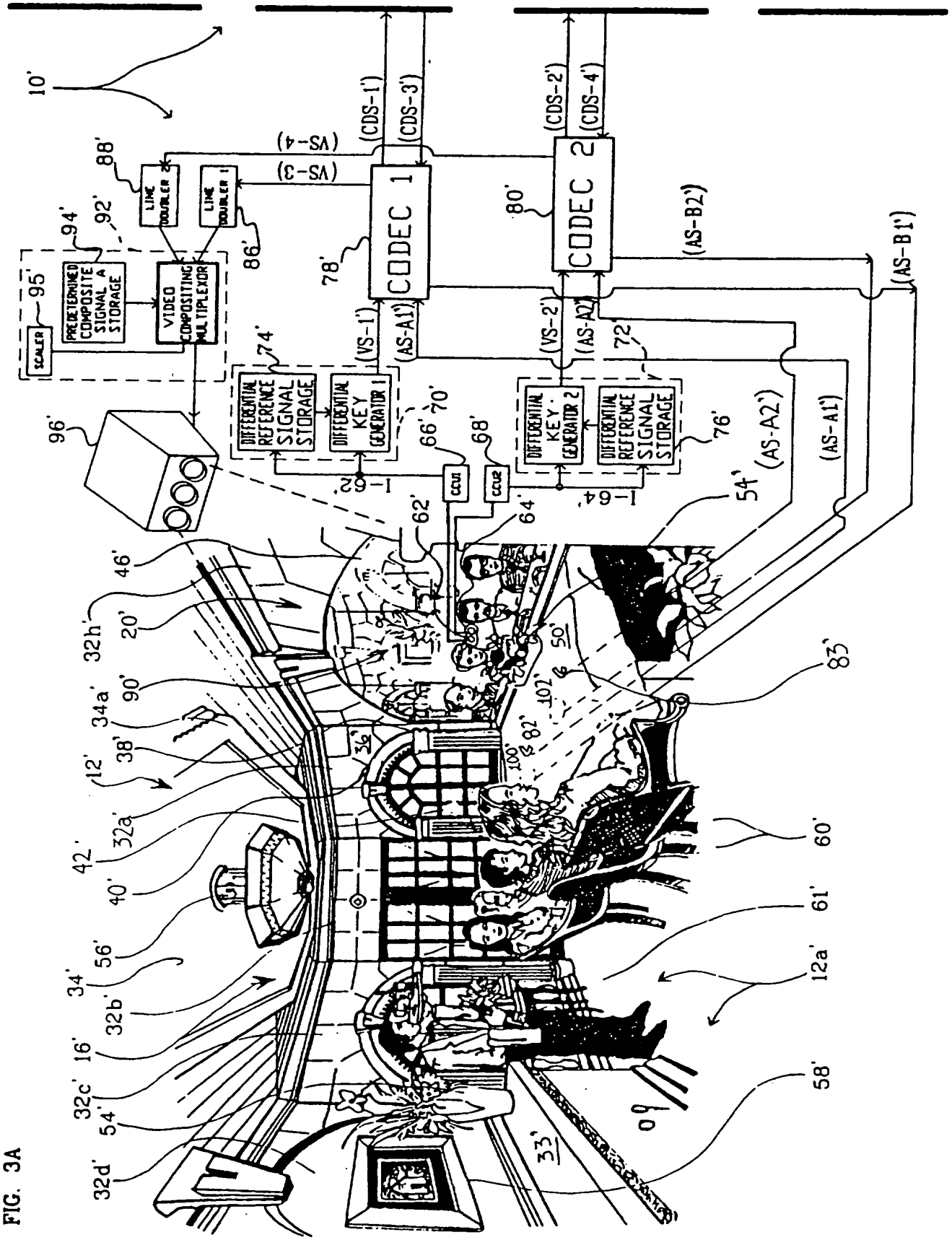

10'
(CDS-1')
(CDS-3')
(CDS-2')
(CDS-4')
(VS-4)
(VS-3)
88'
LINE DOUBLER 2
LINE DOUBLER 1
86'
92'
94'
95'
SCALER
PREDETERMINED COMPOSITE SIGNAL A STORAGE
VIDEO COMPOSITING MULTIPLEXOR
78'
CODEC 1
80'
CODEC 2
(AS-B2')
(AS-B1')
(VS-1')
(AS-A1')
(VS-2')
(AS-A2')
74'
72'
DIFFERENTIAL REFERENCE SIGNAL STORAGE
DIFFERENTIAL KEY GENERATOR 1
DIFFERENTIAL KEY GENERATOR 2
DIFFERENTIAL REFERENCE SIGNAL STORAGE
76'
96'
66'
70'
68'
62'
64'
54'
46'
20'
32h'
34a'
90'
38'
12'
32a'
42'
40'
56'
34'
32b'
16'
32c'
54'
32d'
50'
83'
102'
82'
100'
36'
60'
61'
12a'
58'
33'

FIG. 3A

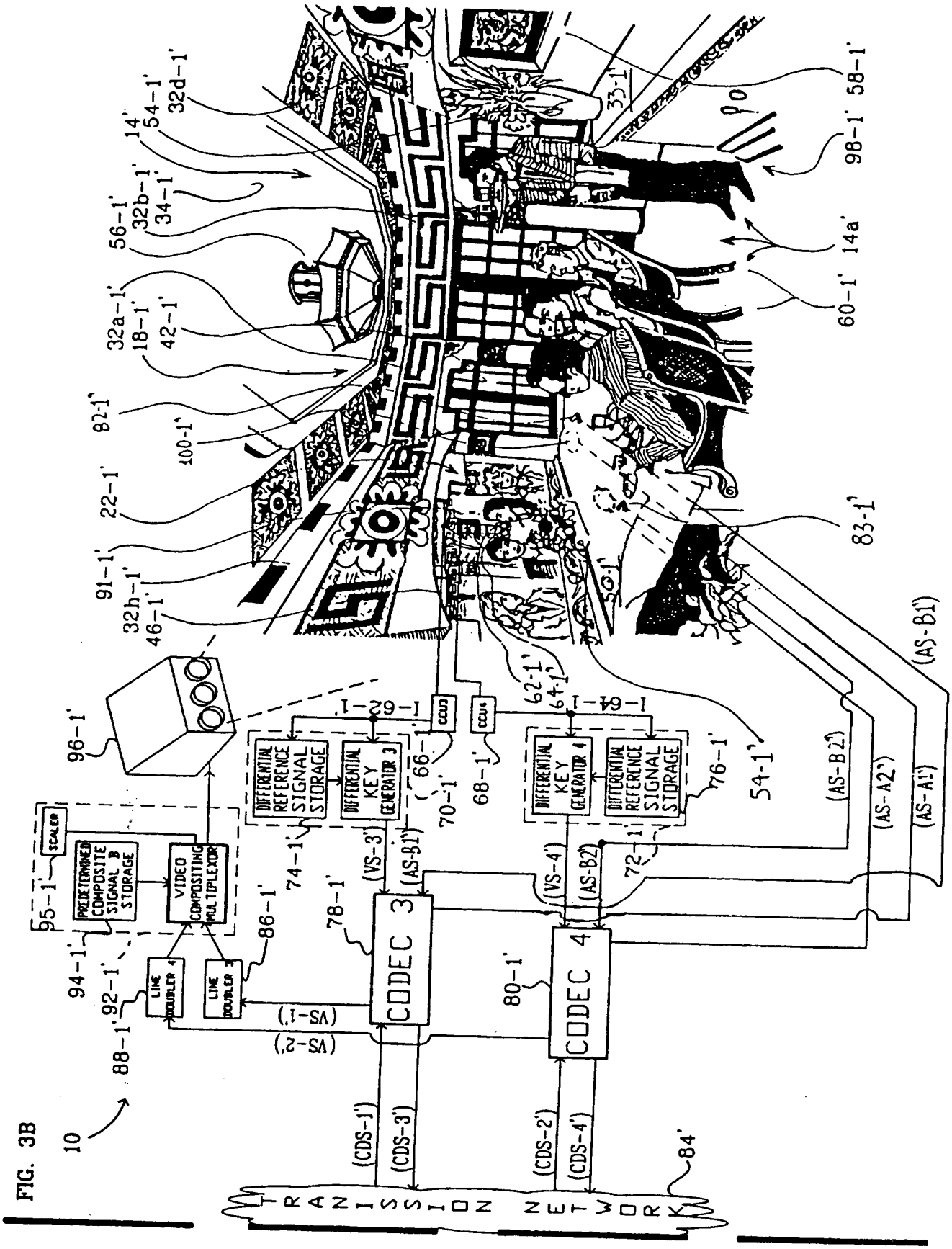

10
88-1'
94-1'
92-1'
95-1'
SCALER
PREDETERMINED COMPOSITE SIGNAL B STORAGE
VIDEO COMPOSITING MULTIPLEXOR
LINE DOUBLER 4
LINE DOUBLER 3
86-1'
74-1'
78-1'
CODEC 3
80-1'
CODEC 4
DIFFERENTIAL REFERENCE SIGNAL STORAGE
DIFFERENTIAL KEY GENERATOR 3
DIFFERENTIAL KEY GENERATOR 4
DIFFERENTIAL REFERENCE SIGNAL STORAGE
70-1'
68-1'
72-1'
76-1'
54-1'
(VS-1')
(VS-2')
(VS-3')
(AS-B1')
(VS-4')
(AS-B2')
(AS-B2')
(AS-A2')
(AS-A1')
(AS-B1')
(CDS-1')
(CDS-3')
(CDS-2')
(CDS-4')
84'
TRANSMISSION NETWORK
96-1'
82-1'
100-1'
22-1'
91-1'
32b-1'
46-1'
32a-1'
18-1'
42-1'
56-1'
32b-1'
34-1'
14'
54-1'
32d-1'
62-1'
64-1'
66-1'
50-1'
33-1'
98-1'
58-1'
14a'
60-1'
83-1'

FIG. 3B

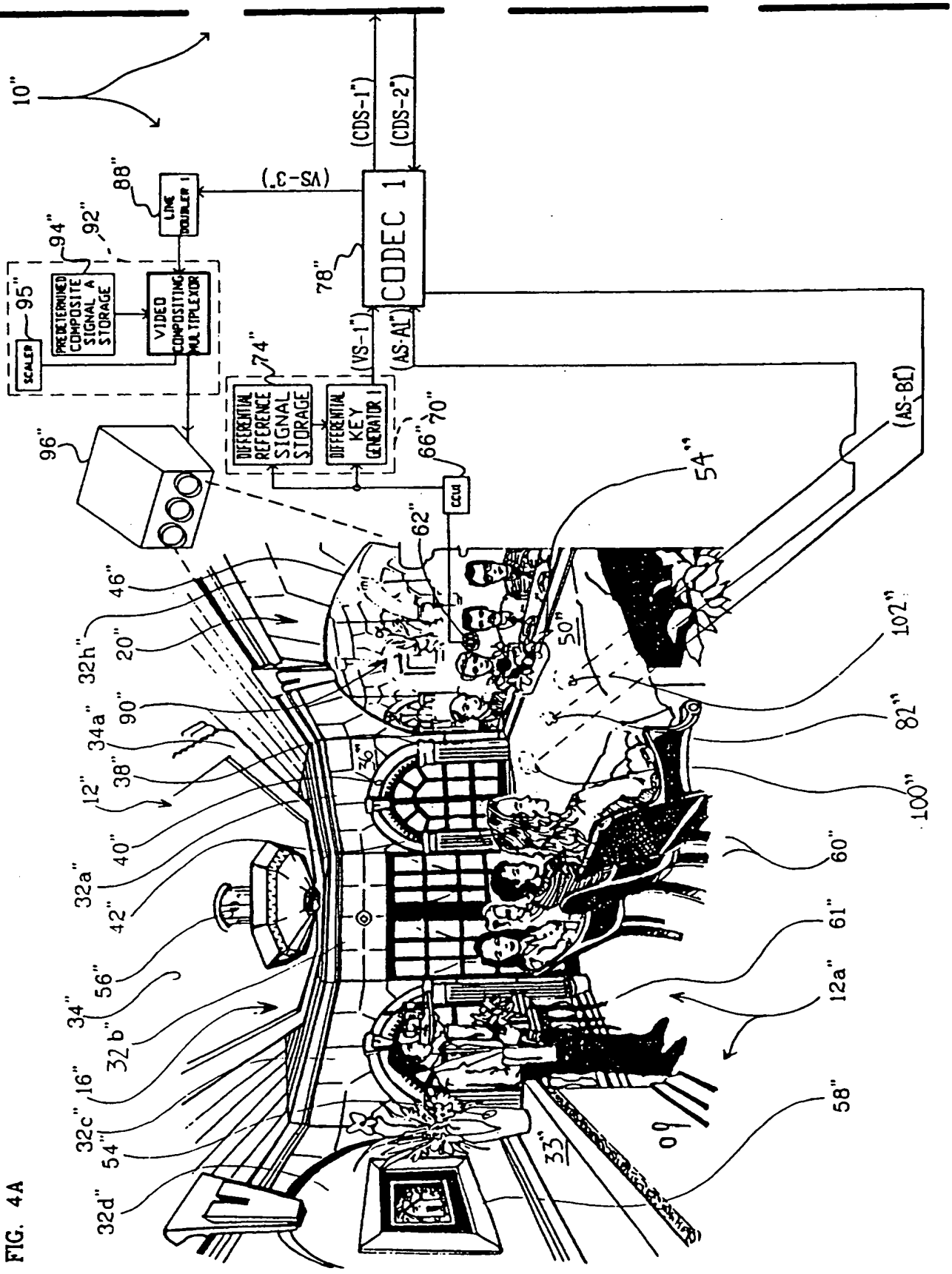

10"
(CDS-1")
(CDS-2")
88"
(VS-3")
LINE DOUBLER 1
94"
92"
78"
CODEC 1
95"
SCALER
PREDETERMINED COMPOSITE SIGNAL A STORAGE
VIDEO COMPOSITING MULTIPLEXOR
74"
(VS-1")
(AS-A1")
DIFFERENTIAL REFERENCE SIGNAL STORAGE
DIFFERENTIAL KEY GENERATOR 1
96"
66"
70"
CCU
62"
54"
(AS-B1")
46"
32h"
20"
50"
102"
34a"
90"
82"
12"
38"
36"
100"
40"
32a"
60"
42"
61"
56"
12a"
34"
32b"
16"
58"
32c"
54"
33"
32d"

FIG. 4A

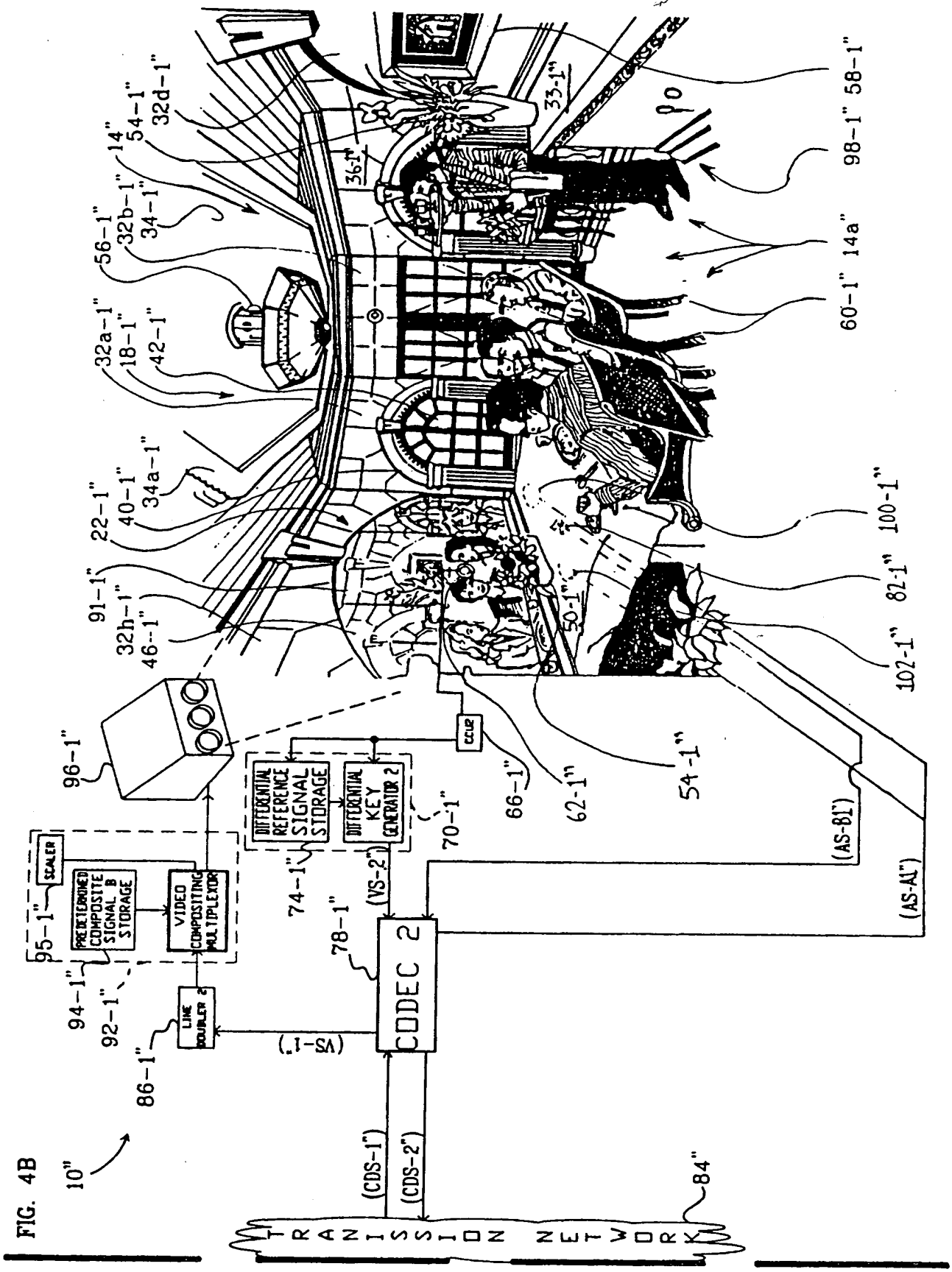

10"
TRANSMISSION NETWORK
84"
(CDS-1")
(CDS-2")
CODEC 2
78-1"
(VS-1")
(VS-2")
LINE DOUBLER 2
86-1"
92-1"
94-1"
95-1"
SCALER
PREDETERMINED COMPOSITE SIGNAL B STORAGE
VIDEO COMPOSITING MULTIPLEXOR
74-1"
DIFFERENTIAL REFERENCE SIGNAL STORAGE
DIFFERENTIAL KEY GENERATOR 2
70-1"
CCUB
66-1"
62-1"
54-1"
(AS-B1")
(AS-A1")
96-1"
91-1"
32h-1"
46-1"
22-1"
40-1"
34a-1"
32a-1"
18-1"
42-1"
56-1"
32b-1"
34-1"
14"
54-1"
32d-1"
36-1"
33-1"
60-1" 14a"
98-1" 58-1"
50-1"
100-1"
82-1"
102-1"

FIG. 4B

FIG. 5A

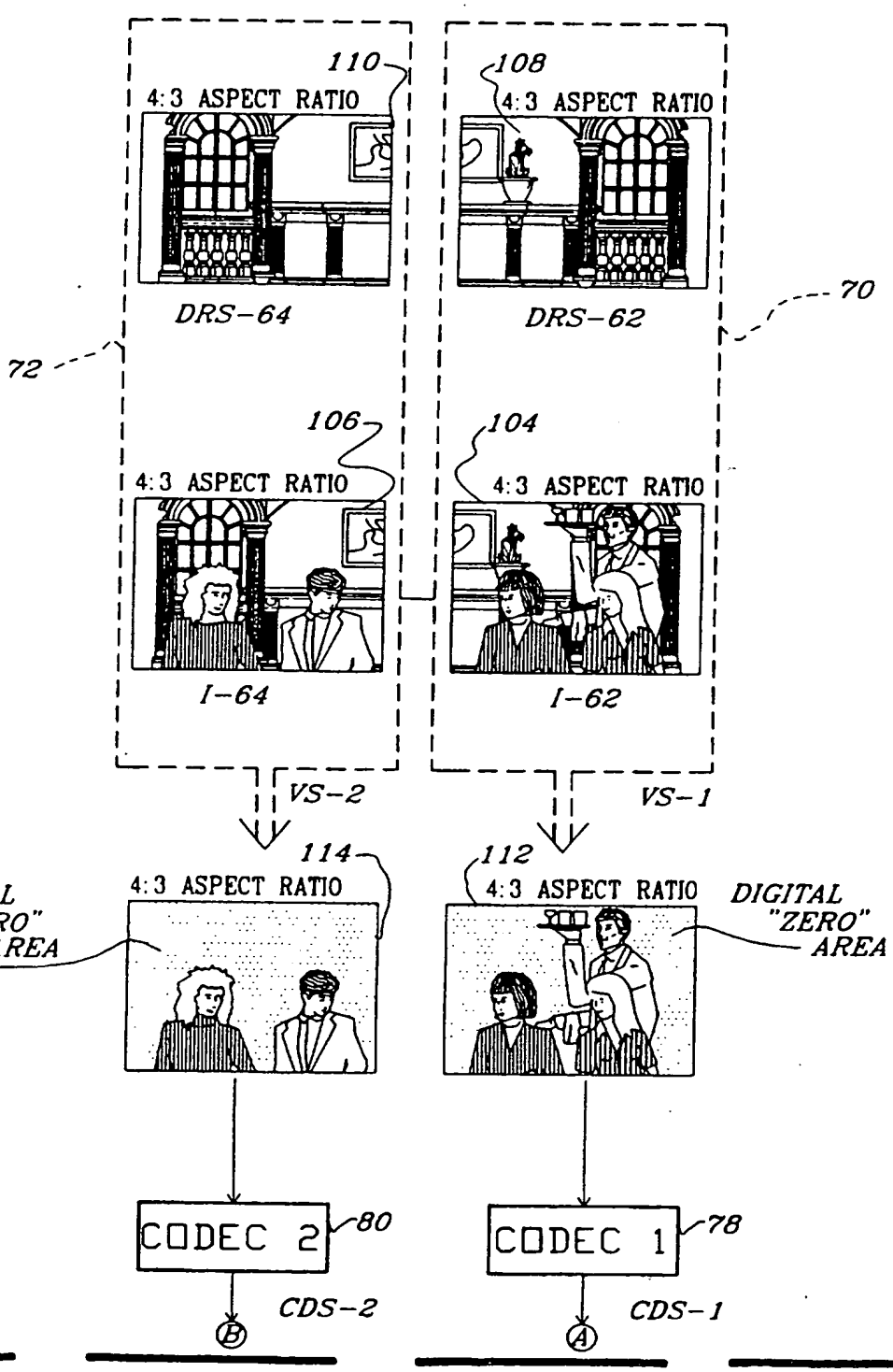

FIRST STATION 12
110
4:3 ASPECT RATIO
108
4:3 ASPECT RATIO
DRS-64
DRS-62
70
72
106
4:3 ASPECT RATIO
104
4:3 ASPECT RATIO
I-64
I-62
VS-2
VS-1
114
4:3 ASPECT RATIO
112
4:3 ASPECT RATIO
DIGITAL "ZERO" AREA
DIGITAL "ZERO" AREA
CODEC 2
80
CODEC 1
78
CDS-2
CDS-1
B
A

FIG. 5B

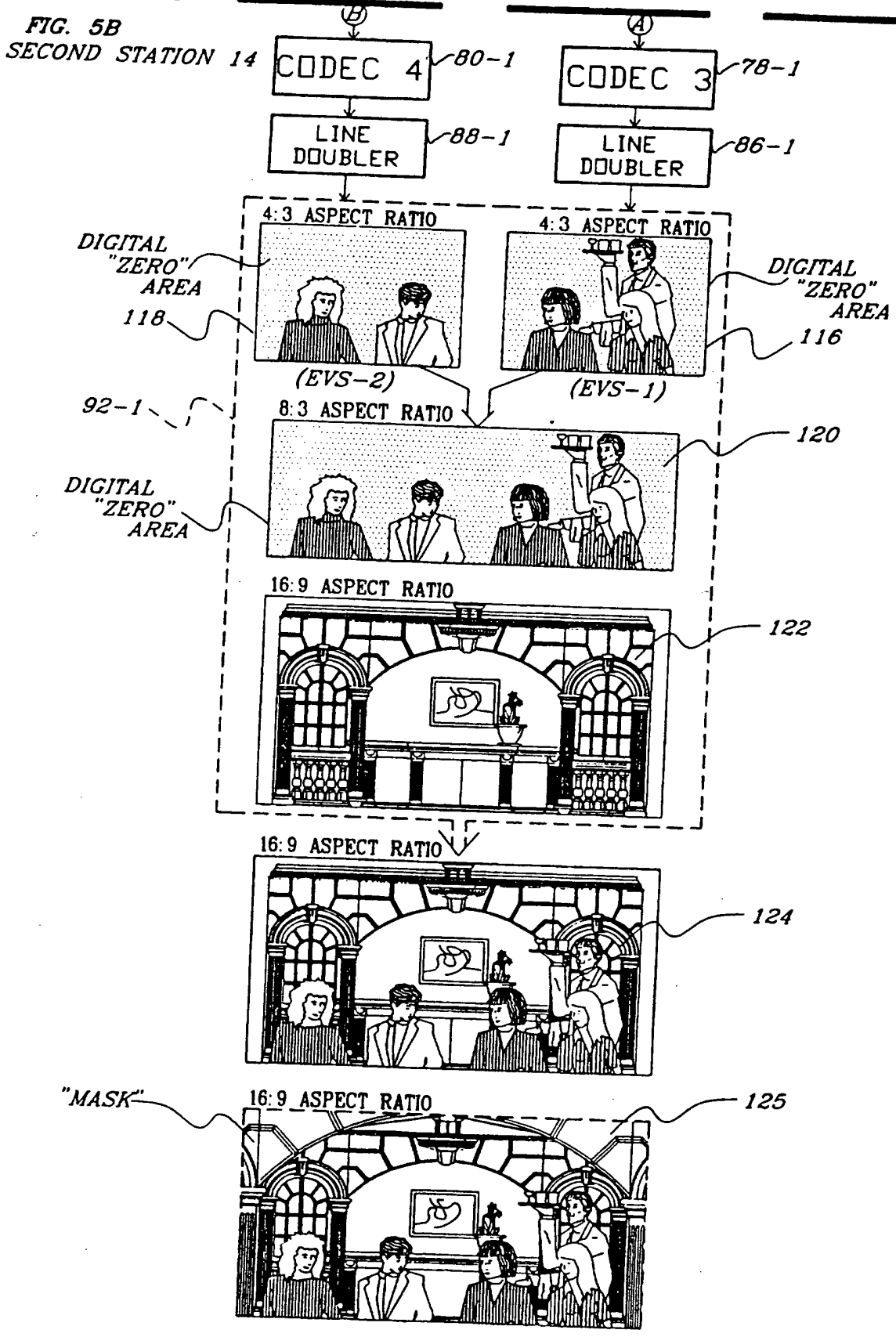

SECOND STATION 14
CODEC 4
80-1
CODEC 3
78-1
LINE DOUBLER
88-1
LINE DOUBLER
86-1
4:3 ASPECT RATIO
4:3 ASPECT RATIO
DIGITAL "ZERO" AREA
118
(EVS-2)
(EVS-1)
DIGITAL "ZERO" AREA
116
92-1
8:3 ASPECT RATIO
120
DIGITAL "ZERO" AREA
16:9 ASPECT RATIO
122
16:9 ASPECT RATIO
124
"MASK"
16:9 ASPECT RATIO
125

FIG-6A

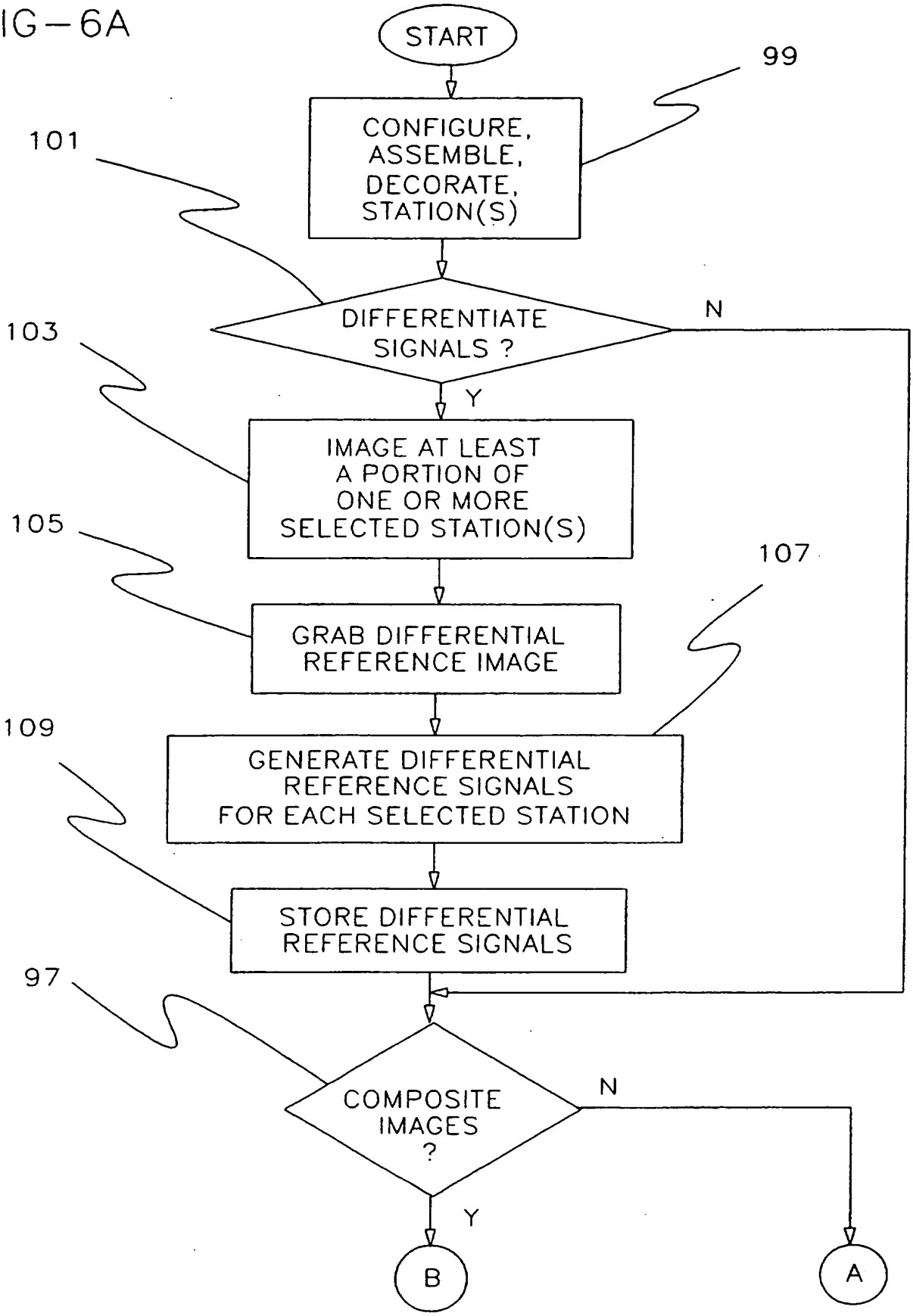
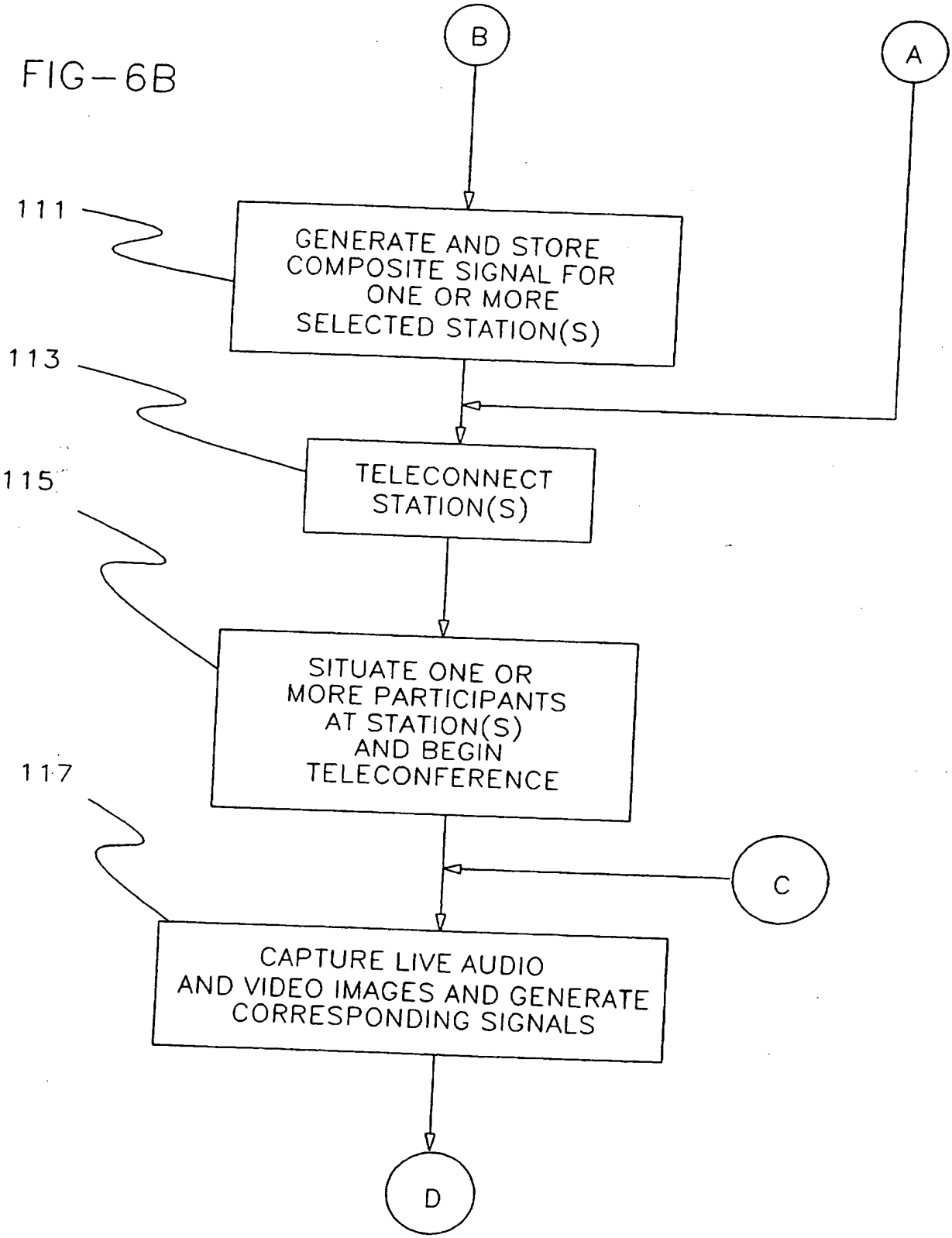

START
99
CONFIGURE, ASSEMBLE, DECORATE, STATION(S)
101
DIFFERENTIATE SIGNALS ?
N
Y
103
IMAGE AT LEAST A PORTION OF ONE OR MORE SELECTED STATION(S)
105
GRAB DIFFERENTIAL REFERENCE IMAGE
107
109
GENERATE DIFFERENTIAL REFERENCE SIGNALS FOR EACH SELECTED STATION
STORE DIFFERENTIAL REFERENCE SIGNALS
97
COMPOSITE IMAGES ?
N
Y
B
A

FIG-6B


B
A
111
GENERATE AND STORE COMPOSITE SIGNAL FOR ONE OR MORE SELECTED STATION(S)
113
TELECONNECT STATION(S)
115
SITUATE ONE OR MORE PARTICIPANTS AT STATION(S) AND BEGIN TELECONFERENCE
117
C
CAPTURE LIVE AUDIO AND VIDEO IMAGES AND GENERATE CORRESPONDING SIGNALS
D

FIG—6C

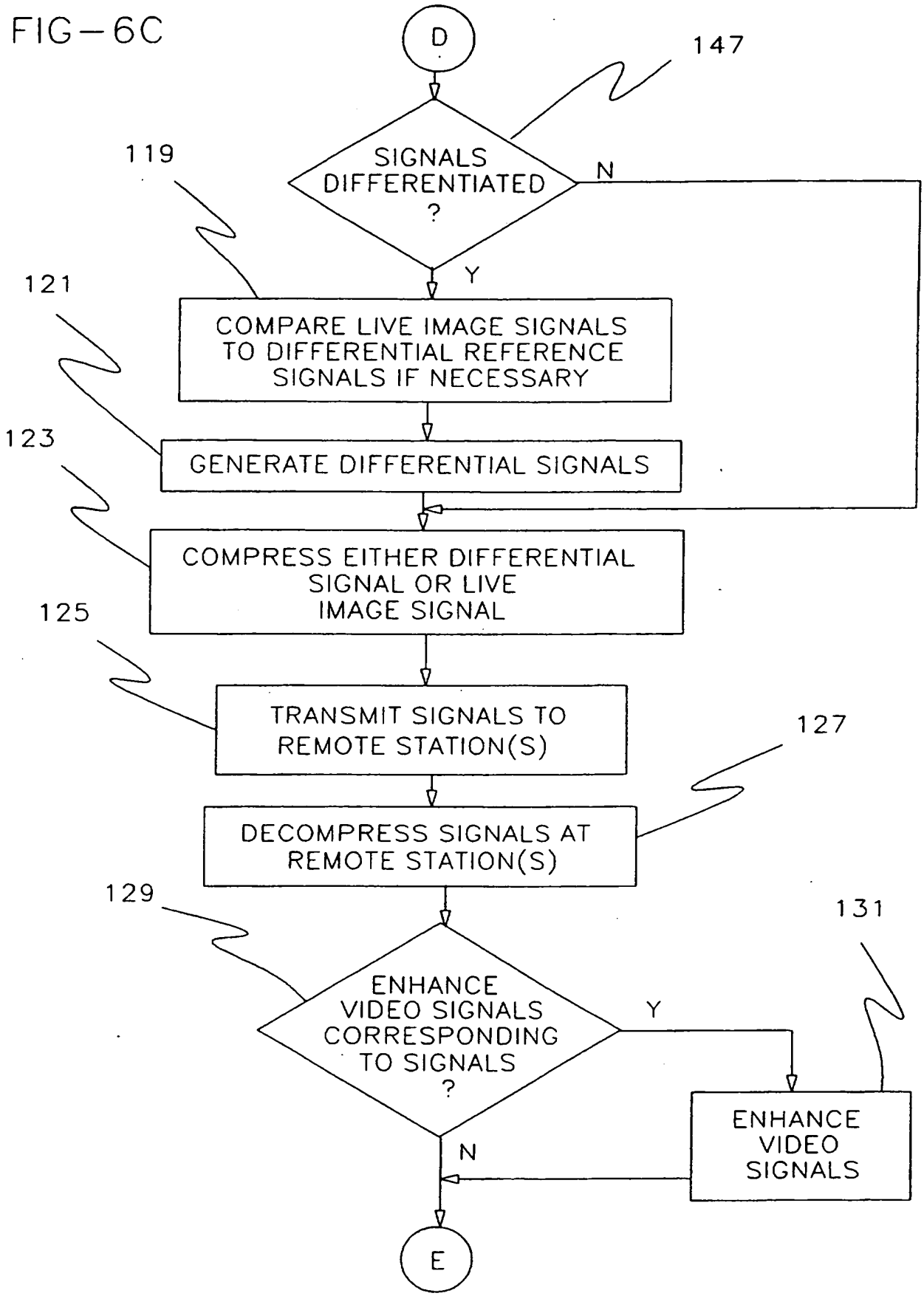
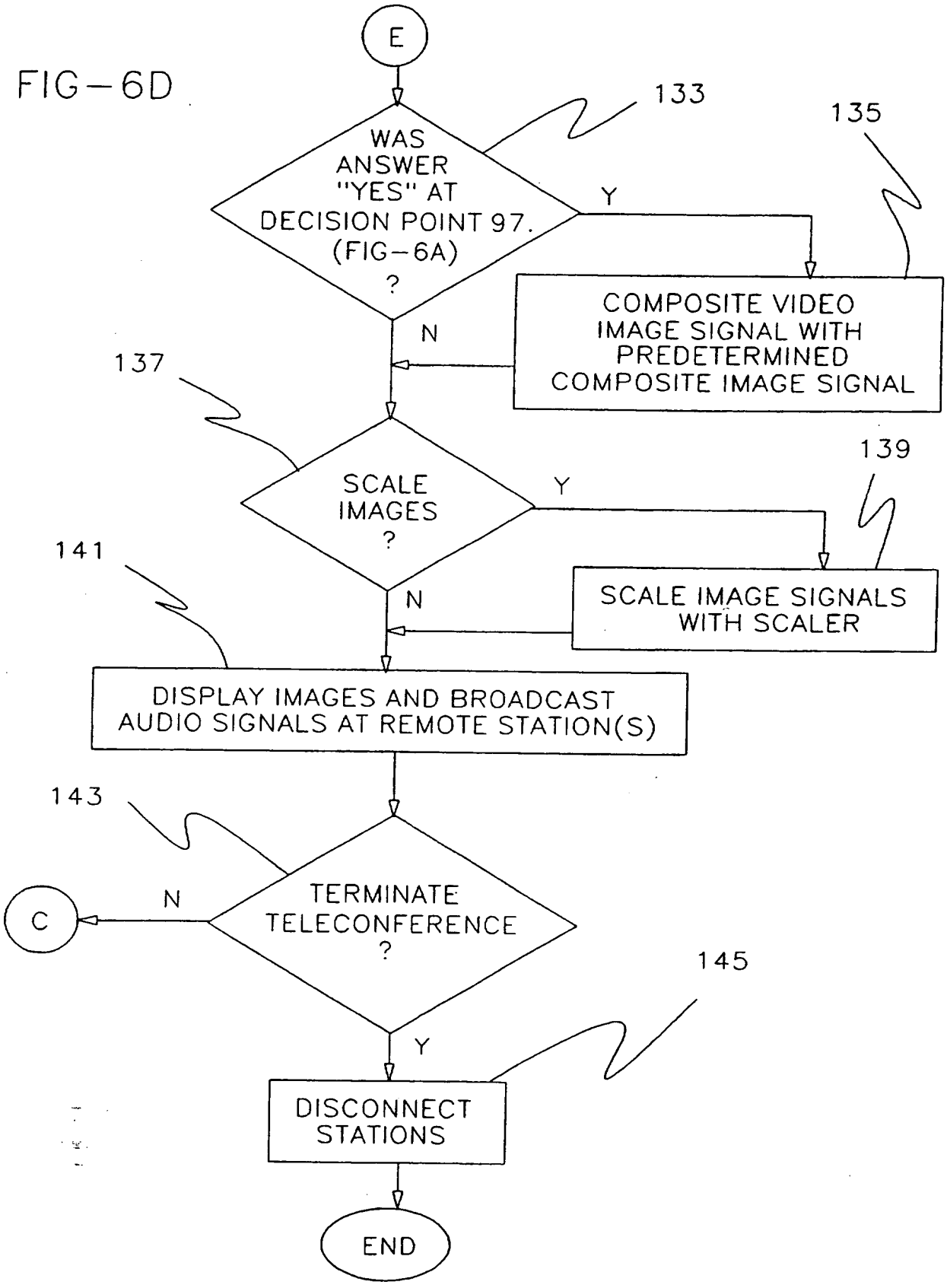

D
147
SIGNALS DIFFERENTIATED ?
N
Y
119
121
COMPARE LIVE IMAGE SIGNALS TO DIFFERENTIAL REFERENCE SIGNALS IF NECESSARY
123
GENERATE DIFFERENTIAL SIGNALS
COMPRESS EITHER DIFFERENTIAL SIGNAL OR LIVE IMAGE SIGNAL
125
TRANSMIT SIGNALS TO REMOTE STATION(S)
127
DECOMPRESS SIGNALS AT REMOTE STATION(S)
129
131
ENHANCE VIDEO SIGNALS CORRESPONDING TO SIGNALS ?
Y
N
ENHANCE VIDEO SIGNALS
E

FIG-6D


E
133
WAS ANSWER "YES" AT DECISION POINT 97. (FIG-6A) ?
135
Y
COMPOSITE VIDEO IMAGE SIGNAL WITH PREDETERMINED COMPOSITE IMAGE SIGNAL
N
137
SCALE IMAGES ?
139
Y
SCALE IMAGE SIGNALS WITH SCALER
141
N
DISPLAY IMAGES AND BROADCAST AUDIO SIGNALS AT REMOTE STATION(S)
143
TERMINATE TELECONFERENCE ?
N
C
145
Y
DISCONNECT STATIONS
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/11802

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04N 7/14; H04M 11/00
US CL :348/15
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4,890,314 (JUDD ET AL) 26 December 1989, see col. 9 lines 22-56.	62-65
---		---
Y		10,43,54, 59
X	US, A, 4,546,383 (ABRAMATIC ET AL) 08 October 1985, see entire patent.	1-7,10-12,18,19,23,25-29,32,33,36-38,41,44,48-53,55-58,60,66-74

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 19 NOVEMBER 1995	Date of mailing of the international search report 27 DEC 1995
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer WING F. CHAN Telephone No. (703) 305-4750

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/11802

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US, A, 5,347,306 (NITTA) 13 September 1994, see entire patent.	13-17,20-22,24,26,30-35,39,40,45-48,52-54,56,57,62-64,67,69,72,75 ----- 1-12,18,19,23,25,27-29,36-38,41-44,49-51,55,58,59,60,65,66,68,70,71,73,74
Y	US, A, 5,159,451 (FAROUDJA ET AL) 27 October 1992, see col. 1 lines 38-54.	8,9,42,61
Y	US, A, 4,800,432 (BARNETT ET AL) 24 January 1989, see astract.	66

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/11802

B. FIELDS SEARCHED
Minimum documentation searched
Classification System: U.S.

348/14-20,122,211,401,439,448,451,452,458,459,552,581,584,588,591,592,598,606,632,911;379/93,96-99,201,202

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